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The Conditioned Reflex Technique Applied to a Less Specialized Type of Learning

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MUCH has been written concerning the conditioned reflex, and numerous extensive experimental investigations have been conducted in order to determine the methods and techniques by which the reflex may most efficiently be conditioned. As a result of these studies, the conditioned reflex technique has been established as one of the prominent psychological methods of studying certain types of behavior phenomena.

Although many of the problems involved in the conditioning of reflexes were considered before Pavlov's conditioned reflex technique was established, the theory of cultural learning was developed largely as the result of Pavlov's studies. This theory attempts to explain all modifications of behavior on the basis of the conditioned reflex. Allport's (1)[1] theory of the development of social behavior, Watson's (19) behaviorism, and Smith and Guthrie's (14) work are typical of this concept.

If the conditioned reflex theory of learning is applicable to all kinds of everyday learning, the conditioned reflex technique applied to a less specialized type of learning should yield valuable data concerning the learning process.

A survey of the literature concerning the applicability of the conditioned reflex theory to all modifications of behavior indicates that there is a scarcity of experimental studies which have definitely applied the conditioned reflex technique to the less specialized types of learning. Studies such as those of Jones (9) and of Watson and Rayner (20) do, however, in a general way demonstrate the application of the conditioned reflex techinque in modifying emotional behavior. Thorndike (17), in his investigation of what he calls "the principle of belongingness," seems to have very definitely used a phase of the conditioned reflex technique. Thorndike, however, does not consider this type of learning conditioning.

There also seems to be some uncertainty among students of the conditioned reflex phenomena as to whether all of the so-called conditioned reflexes are really true reflexes. Tolman (18) limits conditioned reflex learning to the conditioning of the true reflex; i.e., attaching of the original unconditioned response to the conditioned stimulus. There are other aspects of the conditioning process, however, which are much less specialized than the true conditioned reflex. Tolman has called this aspect of conditioning "sign learning." Sign learning, according to Tolman, consists of the everyday type of learning in which one learns to respond to a stimulus in a different way from that in which he first responded to it. This interpretation seems to be supported by Cason (4), who says there is considerable doubt whether all the conditioned reactions which have been secured were true conditioned reflexes.

[1] Numbers refer to references at the close of the article.

The conditioned reflex technique.—In order to establish a conditioned response there must be a stimulus capable of eliciting a response (the unconditioned stimulus) and another stimulus to which the response is not attached (the conditioned stimulus), and these two stimuli must be presented in rather close temporal relationship. The conditioned response is established when the inappropriate stimulus is substituted for the unconditioned stimulus. It is generally considered that in the everyday type of learning either side (the S or the R) of the response mechanism may be conditioned.

An important aspect of the conditioned reflex technique is the method of presenting the stimulus relative to time relationship. The conditioned stimulus may be simultaneous with, it may precede, or it may follow the unconditioned stimulus. In this investigation the following names are used to distinguish the three time relationships:

1. Simultaneous. The conditioned stimulus and the unconditioned stimulus are presented simultaneously.
2. Delayed. The conditioned stimulus precedes the unconditioned. The two do not overlap in time.
3. Backward. The conditioned stimulus follows the unconditioned. The two do not overlap in time.

Studies of the true conditioned reflex have shown that the simultaneous method of presenting the unconditioned and the conditioned stimuli is the most efficient method for establishing the conditioned reflex. The next in order of ease of establishment is the delayed method, and the most difficult is the backward technique. It has also been found that conditioned reflexes are generally unstable and soon fade away.

The conditioned reflex theory assumes that all learning reduces to conditioned reflexes. If the conditioned reflex technique as described is applied to a simple, unspecialized type of learning comparable to everyday learning situations as contrasted to the highly specialized reflex, a number of questions pertinent to learning efficiency are raised:

1. Does the modification of less specialized behavior by the conditioned reflex technique follow the same laws as does the conditioning of the true reflexes?
2. Which of the three methods of presenting the stimulus (simultaneous, delayed, or backward) is most efficient for learning?
3. Is less specialized behavior that is modified by the conditioned reflex technique unstable, and does it soon fade away?
4. What effect does the length of the time interval between the presentation of terms have upon the efficiency of learning?
5. Will learning efficiency be affected if the time intervals are filled with interpolated activities?
6. Will learning be facilitated by certain kinds of interpolated activities and be retarded by others?
7. By which method of presenting terms (simultaneous, delayed, or backward) will learning be most stable (remembered best)?
8. Is the intelligence of the subjects an important factor in less specialized learning by the conditioned reflex?

The purpose of this study is to investigate experimentally the effect of each of the above conditions on learning efficiency.

A study of the literature concerning the problems listed above necessitates an analysis of most of the experimental work that has been done, both with the conditioning of the true reflexes and with all other studies of learning. Few of these studies are, however, directly comparable to this investigation; but there are certain studies which have important findings pertinent to some of our problems.

Pavlov's (12) findings relative to our problems are interesting. He found, in working with the true reflex, the salivary, that: (1) the simultaneous method of presenting stimuli was most effective; (2) the length of the time interval between the unconditioned and the conditioned stimulus was a determining factor in the case of conditioning; (3) if the conditioned stimulus preceded the unconditioned, conditioning was extremely difficult; and (4) modifications of reflex behavior by conditioning were quite unstable and soon faded away. Wolfle (21), investigating the reflex jerk of the finger, found backward conditioning difficult. She also found that the length of the time interval between terms was important in the case of conditioning.

Froeberg (6), working with nonsense syllable pairs, found that the longer time interval and interpolated activities between terms reduced learning. Bergstrom's (2) results in a somewhat similar study would indicate that the optional interval between terms depends at least in part upon the type of material to be learned. Perhaps the most important of all studies dealing with the effect of time in learning is that of Snoddy (15). In his very elaborate study, Snoddy showed that time in relation to maturation (experience) must be considered if learning is to be efficient.

The theory has been advanced that association never takes place between terms unless they are presented simultaneously. The proponents of this theory insist that, where associations do take place between terms separated by a time interval, it is because of the fact that, when the second term is presented, the verbal, mental, motor, or kinaesthetic image of the first is reproduced, hence it reduces to simultaneity of presentation. The soundness of this theory seems not to have been definitely demonstrated by experimental investigations.

One can find much relevant material concerning the problem of interpolated activities between terms in studies dealing with the phenomena of retention. Studies which involved interpolated activities which affected learning and retention, "retroactive inhibition," and "perseveration" are rather numerous. One of the earlier studies which was definitely concerned with the problem of retroactive inhibition and perseveration was that of Müller and Pilzecker (11). Their investigations, using nonsense syllables as the material to be learned and retained, with the interpolated activities being rest, memorizing a second list of syllables, or memorizing pictures, found that the perseverative process was most influential immediately after learning and then gradually lost its effect. Heine (8) and De Camp (5), investigating the same problems, secured conflicting results. Heine's conclusions were in general in line with those of Müller and Pilzecker; but De Camp found little difference in results

when an interpolated activity of multiplication was compared to a rest period.

The most extensive study of the effect of the similarity of interpolated activities to the retention of the original materials is that of Robinson (13). Three experiments were performed. In each experiment several interpolated activities were inserted, varying from very similar tasks to those which were quite dissimilar. The results of these three experiments showed in each case that the highly similar interpolated tasks affected learning efficiency most and those which were least similar affected learning least.

Learning materials.—After considerable experimentation with different types of materials, 30 pictures of objects and people in color and approximately 7"x10" in size, were selected as being the most satisfactory type of learning materials. The pictures were mounted on 9"x12" colored drawing paper and each picture was given a two-word name. There was no connection, either in current use, or of the elements in the picture, between the name and the picture. By random selection the 30 pictures were divided into three groups of 10 each. The three groups of pictures were labeled respectively simultaneous, delayed, and backward. Each picture was rotated through the three methods of presentation so that any differences in case of association would be equally distributed. These pictures were named the major pictures in order to distinguish them from the interpolated minor pictures.

Five different time intervals (20, 30, 40, 50, and 60 seconds) between the presentation of terms were studied and five different activities (rest, arithmetic, pied type, names, and pictures) were interpolated during the time interval between the presentation of terms. The different learning situations are shown in Table I. It will be noted that the effect on learning efficiency of interpolated (filled) activities for all the time intervals was studied except interpolated pictures during the 20-second interval. The numbers refer to the number of subjects in each learning situation.

TABLE I. LEARNING SITUATIONS—IMMEDIATE TEST GROUP

Length of Interval in Seconds	Unfilled Rest	Filled Arithmetic	Filled Pied Type	Filled Names	Filled Pictures
20	23	14	21	20	.....
30	27	21	14	20	14
40	19	26	37	16	12
50	24	21	20	15	30
60	40	24	34	14	14
Total Number of Subjects	133	106	126	85	70

The interpolated activities varied from highly dissimilar tasks to tasks which were quite similar to the major learning. The arithmetic problems included addition, subtraction, multiplication, and division;

the pied type was single-spaced; each name consisted of two words and was quite similar to, although not the same as, the names of the major pictures; the minor pictures were approximately one-half the size of the major pictures and were mounted on colored drawing paper. The pictures were given names consisting of two words and the name was descriptive of the picture.

Experimental procedure.—Preliminary investigation indicated that the number of subjects involved in the learning at any one time was not an important consideration provided each subject could be seated so that he could plainly see the pictures and distinctly hear the names. The average number of subjects for each learning situation, however, was seven, with a range of from 1 to 20. The laboratory in which the experiment was conducted consisted of a quiet, well-lighted room where objective distractions were held to a minimum.

The conditioned reflex technique was thoroughly explained to the subject before the learning materials were presented. The subjects were definitely informed of just what they were expected to learn and how the efficiency of their learning would be tested. In order to be sure the explanations were fully understood, materials similar to the learning materials were used to demonstrate each phase of the learning situation.

At the beginning of each learning situation the following additional information and directions were given the subjects. "You will be shown 30 pictures. Each picture will be presented for a period of 10 seconds and its name will be distinctly spoken twice. There will be a 10-second interval between each completed unit (picture-name) of the picture series and the next unit. For 10 of these pictures, the picture and the name will be given at the same time; for 10 the name will be given a unit of time preceding the picture; and for 10 the name will be given a unit of time after the picture has been shown. The order in which the names and pictures are presented, however, will be an entirely chance order. Your task is to learn and remember the correct name for each picture so that when the pictures are again presented you can give their correct names."

In order to assure a chance arrangement of the simultaneous, delayed, and backward pictures, they were shuffled like playing cards before each presentation. The method of testing learning efficiency was the same for all learning situations. As soon as the last of the learning terms had been presented the subjects were told to relax, and sheets were handed to them with the numbers from 1 to 30. Exactly three minutes after the last learning term had been presented the pictures were again shuffled and each picture was presented for 10 seconds; but this time only the number of the picture was given, and the subjects were asked to write the name of the picture following the number of their sheets. Learning efficiency was measured on the basis of the number of correct responses. If both words in the name of the picture were given correctly it was scored two points; if one word of the name was given correctly it was scored one point.

One group of subjects, immediate test group, was given only the one test, immediately following the learning period. The other group, re-test

group, was given, in addition to the immediate test, four memory tests at intervals of one week, one week, one week, and two weeks. At no time during this five-week period did the subjects have any opportunity to see the major pictures or review the learning materials in any way. The re-tests were conducted in the same manner as the immediate tests.

The specific procedure for each learning situation was as follows:

Unfilled: The subjects were told to rest during the time interval between terms.

Filled, arithmetic: The subjects were given mimeographed sheets of arithmetic problems and told "When I say 'work,' begin with the first problem and work just as rapidly as you can. You will be graded on both speed and accuracy. Take the problems in order. When I say 'stop,' immediately quit working and give your attention to the experimenter. You have the task of learning the names of the 30 pictures and working correctly as many of the arithmetic problems as you can." Figure 1 shows the plan of presentation of major pictures and the interpolated problems. The figure is for the 20-second interval but is representative of the other time intervals in the series except that the interval for the interpolated activities between the words "work" and "stop" would be 30, 40, 50, or 60 seconds.

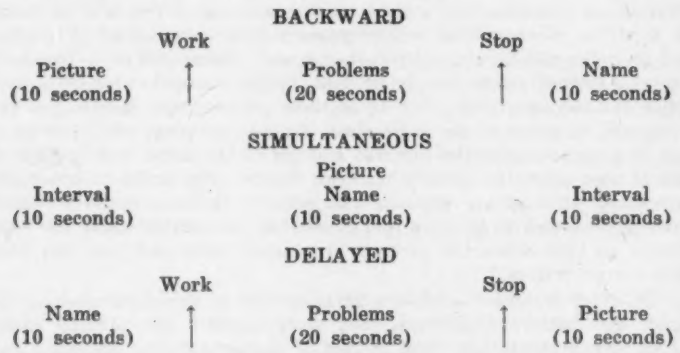

FIG. 1. Plan of Presentation of Major Pictures and Interpolated Activities.

Filled, pied type: Mimeographed sheets of pied type were given the subjects and they were instructed as follows: "When I say 'work,' begin with the first line and check each 'a' (experimenter could have given any letter he desired) just as rapidly as you can. You will be graded on both speed and accuracy; each 'a' unchecked constitutes an error. When I say 'stop,' immediately quit working and give your attention to the experimenter. You have the task of learning the names of the pictures and checking as many letters as possible." If in Figure 1 the term "pied type" is substituted for the word "problem," it will be representative of the method of presenting the pictures and the interpolated activity.

Filled, names: "During the time interval between the name and the picture and between the picture and the name for the delayed and backward presented pictures I shall give you other names. Your task is to learn the names of the pictures and to remember those other names as well. Each of the interpolated names will be spoken twice." If in Figure 1 the word "name" is substitued for the word "problem" the figure will be representative of the way the picture and the interpolated name were presented. For the 20-second interval there was one name; for the 30-second, two; for the 40-second, three; for the 50-second, four; and for the 60-second, five.

Filled, pictures: "During the time interval between the delayed and the backward presented pictures, I shall present other pictures to you. After either the name or the picture of the major learning series there will be a time interval rest period of 10 seconds; then one of the minor pictures will be presented. This picture will be presented for a period of 10 seconds and at the time it is presented its name will be spoken twice. There will be a 10-second rest period preceding the completion of terms of the major learning. Therefore, if you have in this learning situation a time interval between terms of 30 seconds you will be shown one minor picture; if 40 seconds, 2 minor pictures; if 50, 3; and if 60, 4. Your task is to learn the names of both the major and the minor pictures."

Subjects.—The subjects were 608 college students. There were 520 subjects in the immediate test group, and 88 subjects in the re-test group. The age, sex, and class standing of the two groups are given in Tables II, III, and IV.

TABLE II. AGE DISTRIBUTION OF SUBJECTS IN THE TWO GROUPS

Years	Immediate Test Group	Re-test Group
16	6	.....
17	36	10
18	120	17
19	157	25
20	118	16
21	47	7
22	16	3
23-40	20	10
Total	520	88

TABLE III. SEX DISTRIBUTION OF SUBJECTS IN THE TWO GROUPS

Sex	Immediate Test Group	Re-test Group
Male	286	50
Female	234	38
Total	520	88

TABLE IV. CLASS STANDING DISTRIBUTION OF SUBJECTS IN THE TWO GROUPS

Class	Immediate Test Group	Re-test Group
Freshman	265	67
Sophomore	203	11
Junior	35	7
Senior	17	3
Total	520	88

RESULTS

Immediate test group.—In reporting the results a complete analysis of the data will not be attempted since the statistical treatment is rather involved and would take considerably more time than is allotted the speaker. The data which seem to have the most direct bearing on the efficiency of classroom learning will be presented and discussed.

One of the major problems of this investigation as it relates to classroom learning was to learn which of the three time-relationships, simultaneous, delayed, or backward, was conducive to the most efficient learning. In order to study this problem the average scores of the 520 subjects of the immediate test group for the different time intervals and for the different learning situations were computed for each of the three time-relationships. These data are given in Table V. An examination of the data in Table V shows that the simultaneous method of presenting terms was 2.22 units better than the delayed method; the delayed was 1.90 units more efficient than the backward; and the simultaneous was 4.12 units better than the backward. It will be noted that these differences between the average scores are of statistical reliability. When the difference over the standard deviation difference equals 3 or more, the difference between the averages is considered reliable. The differences between the averages in Table V are considerably higher than necessary for complete reliability.

TABLE V. AVERAGE SCORES MADE BY THE 520 SUBJECTS ON THE SIMULTANEOUS, DELAYED, AND BACKWARD TECHNIQUE—IMMEDIATE TEST GROUP

	Simultaneous		Delayed		Backward		Simultaneous
Average	13.10		10.88		8.98		13.10
Difference		2.22		1.90		4.12	
Per cent of loss		16.95		17.50		31.45	
$\frac{D}{S.\ D.\ Diff}$		6.90		5.40		12.90	
Chances in 1,000		999+		999+		999+	

Modifications in learning efficiency resulting from differences in the length of the time intervals between the presentation of terms and from the type of interpolated activities is shown by the data in Table VI. In studying the data in Table VI it can readily be observed that the shortest time interval (20 seconds) is not the best for most efficient learning. If the curves were plotted for these time interval data they would be in the general shape of an inverted letter U, the most efficient time interval for learning being either the 30- or 40-second interval. In relation to the type of interpolated activities the rest interval was superior to any of the filled intervals. Learning was least affected by names and most affected by arithmetic, with pied type and pictures in approximately the middle position. The similarity or lack of similarity of the interpolated activites to the major learning materials was not the important factor in modifying learning efficiency; the changes apparently being due to the degree of concentration demanded by the interpolated activities.

TABLE VI. AVERAGE SCORES FOR EACH TIME INTERVAL AND FOR EACH LEARNING SITUATION ON THE SIMULTANEOUS, DELAYED, AND BACKWARD TECHNIQUE—IMMEDIATE TEST GROUP

Group	20 Seconds	30 Seconds	40 Seconds	50 Seconds	60 Seconds	Mean
Unfilled						
S	13.17	16.41	16.95	15.63	13.43	15.12
D	13.43	16.26	16.37	11.71	14.33	14.42
B	13.57	12.89	14.26	9.67	10.88	12.25
Names						
S	11.85	13.70	15.06	16.40	16.43	14.69
D	9.60	11.95	12.06	15.47	11.86	12.19
B	8.20	11.85	10.63	13.33	12.14	11.23
Pied Type						
S	11.00	13.68	12.11	15.75	12.76	13.06
D	10.48	13.79	11.68	8.85	12.38	11.44
B	7.71	11.07	9.14	5.65	7.79	8.27
Pictures						
S	.....	13.21	13.25	13.93	10.79	12.80
D	.....	10.71	8.17	8.83	4.79	8.12
B	.....	9.71	8.92	7.73	5.93	8.07
Arithmetic						
S	10.57	9.19	10.08	8.43	10.38	9.73
D	11.64	7.95	5.73	5.14	7.96	7.68
B	7.29	4.67	3.08	3.38	6.08	4.90

If the average scores made by the simultaneous, delayed, and backward technique are totaled for each time interval and for each learning situation, the total average scores will show, as did the separate average scores (Table VI), that the 30- to 40-second time interval is the optimal interval for learning. These data are presented in Table VII. If the scores under each time interval are read from top to bottom, it can be seen that learning was most efficient during the unfilled intervals, least affected by interpolated names, and most affected by the working

of arithmetic problems during the intervals between the presentation of terms.

TABLE VII. TOTAL AVERAGE SCORES MADE DURING EACH TIME INTERVAL IN EACH LEARNING SITUATION—IMMEDIATE TEST GROUP

Test	20 Seconds	30 Seconds	40 Seconds	50 Seconds	60 Seconds
Unfilled	40.17	45.56	47.58	37.00	38.63
Names	29.65	37.50	37.75	45.20	40.43
Pied type	29.19	38.71	32.92	30.25	32.94
Pictures	.....	33.64	30.33	30.50	21.50
Arithmetic	29.50	21.81	18.88	17.00	24.42

Re-test group.—The 88 subjects in the re-test group were given, in addition to the test immediately following the presentation of the major pictures, four subsequent tests. These were given at intervals of one week between the first three tests, and an interval of two weeks preceding the last test, a total of five tests. The interpolated activities for this group were identical to those of the immediate test group. Only one time interval, the 30-second, however, was studied. The average scores made by the re-test group for each learning situation are given in Table VIII.

TABLE VIII. AVERAGE SCORES MADE IN EACH LEARNING SITUATION FOR EACH TEST—RE-TEST GROUP

Group	Test 1	Test 2	Test 3	Test 4	Test 5
Unfilled					
S	15.18	12.54	11.91	13.09	11.00
D	14.65	10.90	11.27	11.73	11.44
B	13.82	11.00	11.36	11.45	10.44
T	43.65	34.44	34.54	36.27	32.88
Names					
S	9.40	7.20	6.10	7.25	6.60
D	5.45	3.50	3.60	3.70	4.25
B	4.85	3.60	4.05	3.85	3.80
T	19.70	14.30	13.75	14.80	14.65
Pied Type					
S	12.25	9.19	7.60	8.93	8.86
D	9.93	7.00	7.13	8.64	8.71
B	8.13	6.56	6.27	7.00	7.36
T	30.31	22.75	21.00	24.57	24.93
Pictures					
S	10.63	8.21	7.68	9.13	8.38
D	7.83	6.21	6.86	7.04	7.00
B	5.12	3.75	3.14	3.48	4.19
T	23.58	18.17	17.68	19.65	19.57
Arithmetic					
S	12.71	8.59	7.90	9.38	8.19
D	10.41	5.53	5.70	6.12	6.06
B	7.00	5.41	5.36	5.75	6.63
T	30.12	19.53	18.96	21.25	20.88

Our particular interest in the scores made by the re-test group is to determine whether learning of the type involved in this study by the conditioned reflex technique is unstable and soon lost; and by which method, simultaneous, delayed, or backward, the learning is retained best. An examination of the average scores presented in Table VIII shows that the scores were highest for Test 1 (immediate test) but that there was neither a rapid nor uniform loss. In fact these data show that in testing, if materials learned cannot be immediately tested, a period of from three to four weeks later will show the best results. The importance of time to learning efficiency shows here in the longer interval as it did for the shorter intervals with the immediate test group. Learning for the re-test group was more efficient when the terms were presented simultaneously, less efficient when presented by the delayed method, and still less when the appropriate stimulus was presented before the inappropriate. The change in scores from one test period to another is, however, statistically the same regardless of the method of presenting the terms; i.e., although learning was less efficient by the

TABLE IX. DISTRIBUTION OF SCORES IN RELATION TO THE INTELLIGENCE OF THE SUBJECTS—IMMEDIATE TEST GROUP

	Groups According to Percentile Rating				
Percentile rating	1-25	26-50	51-75	76-100	1-25
Average	13.19	37.86	63.33	86.37	13.19
Number	125	135	130	130	125
Simultaneous—					
Average	10.72	11.88	13.79	14.74	10.72
Diff.		1.16	1.91	0.95	4.02
D		2.14	3.99	1.76	6.70
S. D. Diff					
Chances in 1,000		985	999+	965	999+
Delayed—					
Average	7.93	10.25	12.26	13.05	7.93
Diff.		2.32	2.01	0.79	5.12
D		3.36	3.19	1.34	7.88
S. D. Diff					
Chances in 1,000		999+	999+	910	999+
Backward—					
Average	6.01	8.17	9.81	11.00	6.01
Diff.		2.16	1.64	1.19	4.99
D		3.54	2.78	1.92	7.92
S. D. Diff					
Chances in 1,000		999+	997	973	999+
Totals—					
Average	24.66	30.30	35.86	38.79	24.66
Diff.		5.64	5.56	2.93	14.13
D		3.32	3.48	2.03	8.00
S. D. Diff					
Chances in 1,000		999+	999+	980	999+

backward technique, the percentage retained for each test period was similar.

The efficiency of learning in relation to the intelligence[2] of the subjects was studied by computing the average scores made by the simultaneous, delayed, and backward technique in four groups selected according to their percentile ratings. The lowest group consisted of those subjects with a rating of from 1 to 25, the second group of from 26 to 50, the third group of from 51 to 75, and the highest group of from 76 to 100. These data are presented in Table IX. The lowest average scores were made by the group of subjects with the lowest percentile rating and the average score increased as the percentile rating increased. The high statistical reliability of the differences between the average scores made by each group shows that intelligence is an important factor in the learning involved in this study.

SUMMARY

To investigate the efficiency of learning by the application of the conditioned reflex technique to a less specialized type of learning, 608 subjects, 520 of whom were tested only immediately following the learning period and 88 of whom in addition to the immediate test were given four additional tests distributed over a period of five weeks, were tested on their ability to learn the names of 30 pictures. Five different time intervals, 20, 30, 40, 50, and 60 seconds, between the presentation of terms were studied and the effect on learning efficiency of the interpolated activities, rest, working arithmetic problems, checking letters in pied type, memorizing names, and learning the names of other pictures, was measured. Some of the more important results of the study are the following:

1. The type of learning studied in this investigation does not follow the same laws as does the conditioning of the true reflex.
2. Of the three methods of presenting terms, simultaneous, delayed, and backward, simultaneous provides the most efficient learning; the backward method is the least efficient.
3. Learning was stable with no tendency for the new response to fade away.
4. Learning was affected by the length of the time interval between the presentation of terms, the most efficient being the 30- or 40-second interval.
5. Learning efficiency was reduced when the interval between the presentation of terms was filled with interpolated activities.
6. Interpolated activities between terms reduced learning efficiency in proportion to the amount of concentration (attention demanded). The similarity or lack of similarity of the interpolated activities to the major learning materials seemed not to be important.

[2] Intelligence was based on the percentile ratings made on the Psychological Examination for High School Graduates and College Freshmen, prepared by L. L. and T. G. Thurstone, published by the American Council on Education.

7. Although more was learned by the simultaneous method of presenting terms, the rate of forgetting for the three methods was the same.
8. In general, retention was better after a three-week interval than it was for a one-, two-, or five-week interval.
9. Learning efficiency varied as the intelligence of the subjects varied.

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Measuring Attainment of the So-Called General Objectives

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THIS group, as I understand it, is made up of people interested in the problem of measurement and appraisal in education. The question that is most fundamental to any consideration of this problem is *what is to be measured.*

In order to see what is now being measured, let us review the testing programs of some typical school systems—at least the achievement testing as contrasted with intelligence testing. Detroit, as an example of a fairly large city system, makes available regularly for its teachers the following tests: one or more reading tests in all grades from grade 1 through 8; one or more arithmetic tests in grades 3 through 6; a handwriting test in grades 3, 4, and 6; a geography test in grade 6; a composition test in grades 4, 6, and 8; a nature study test in grade 2; an English test in grades 3 through 8; freehand lettering tests in mechanical drawing classes; a general mental test, a household mechanics test, and domestic science tests in the junior high school.

I have checked somewhat to find out the educational testing programs in several Michigan cities of medium size and discovered a pattern generally similar to that in Detroit. Reading and arithmetic tests are common to all testing programs. Spelling and handwriting tests appear often; English, geography, and history tests appear much less frequently. Much use is made of tests in elementary and junior high schools but little or nothing is done in the senior high school.

If these school systems are typical, it is obvious that educational measurement is being used by teachers almost exclusively to appraise progress in gaining knowledge and skill in the tool subjects. Little or no attention is being given in most school systems to the measurement of other types of outcomes.

GENERAL OBJECTIVES

This is a situation I am sure that we all deplore. In the last twenty years numerous local, state, and national committees have labored to formulate the major purposes for which the school exists, the objectives it should seek to achieve. All of us are acquainted with the Cardinal Objectives,[1] which were stated originally for secondary education but since then have been recognized as being almost equally appropriate for elementary education. The Cardinal Objectives of Elementary Education,[2] formulated by a committee of the New York Council of Superintendents, likewise are widely known. More recent efforts include the

[1] National Education Association, Committee on the Reorganization of Secondary Education. *Cardinal Principles of Secondary Education.* U.S. Department of the Interior, Bureau of Education, Bulletin No. 35, Washington, D.C., 1918. 32 pp.

[2] New York (State) Council of Superintendents, Committee on Elementary Education. *Cardinal Objectives in Elementary Education.* Second report. University of the State of New York, Albany, October, 1929. 188 pp.

Social-Economic Goals,[3] prepared by an N.E.A. committee, and the Goals of Public Education in Michigan,[4] prepared by the Michigan Educational Planning Commission. Local and state courses of study commonly open with a statement of general objectives. Thus, for example, the much discussed Virginia course[5] gives a long list of aims grouped under (1) emotionalized attitudes, (2) generalizations, and (3) special abilities. The first two of these groups may properly be considered general objectives in the sense that they are not tied up with particular subjects but are expected to be achieved through the school program as a whole.

The measurement movement has become an integral part of modern education. Why? Solely because it has been demonstrated time and again that the systematic use of the measurement of attainment is a helpful means of increasing attainment. Several reasons may be offered. In the first place, the testing of some outcome of instruction directs the attention of supervisors, principals, and teachers to that outcome. If a test in English is used, there is bound to be an increased interest in English. There is much truth in the statement that what is tested will be taught. In the second place, measurement makes it possible for teachers, principals, and supervisors to discover the degree to which teaching is successful and the points at which additional or different teaching is required. A reading test may reveal, for example, that teaching has been much more effective in developing the ability to get the facts from a selection than in developing the ability to get the central thought of a passage. With this information at hand, the teacher may re-direct emphasis intelligently and secure the desired development in every phase of reading ability. In the third place, measurement provides a means whereby the pupil may know how he is progressing, and may discover his particular strengths and weaknesses. Knowledge of the amount and rate of progress is itself an important factor in making additional progress.

If measurement can be of great value in aiding to attain the knowledges and skills sought in the tool subjects, is it not reasonable to apply measurement also to the general objectives for which the school exists? Does it not seem unfortunate that we school people talk so much about making the school train for wise use of leisure or for worthy home membership, and then limit our appraisal to specific skills in reading, writing, and arithmetic?

And yet you may say, "All true, but there are no standard tests available for testing the so-called general objectives." I must admit the truth of this statement, but I believe we are derelict in our duty if we do not address ourselves to the problem and do the best we can. After all, when the first of this series of Indiana Conferences on Educational

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[3] National Education Association, Committee on Social-Economic Goals. *Social-Economic Goals for America.* Reprinted from the *Journal of the National Education Association* 23:5-12, January, 1934.

[4] Michigan Educational Planning Commission. *Goals of Public Education in Michigan.* Michigan Educational Planning Commission, Lansing, 1934. 4 pp.

[5] Virginia State Board of Education. *Tentative Course of Study for Virginia Elementary Schools.* Grades 1-7. Virginia State Board of Education, Richmond, 1934. 560 pp.

Measurements was held in 1914, there were very few valid and reliable measuring instruments available even in the tool subjects. Much has been accomplished since that time in testing the three R's because teachers and supervisors and college specialists have addressed themselves to the problems. If we really value the so-called general objectives, I believe we should set at the task of measuring them, even though crudely at first.

GENERAL APPROACH TO TESTING THE GENERAL OBJECTIVES

The procedure in testing general objectives is substantially the same as in testing more specific outcomes, although the task is unquestionably more difficult. The steps may be listed as:

1. Define the outcome in terms of specific behavior.
2. Arrange test situations in which this behavior may be observed.
3. Provide for adequate records of the observed behavior.
4. Evaluate the behavior.
5. Interpret the results.

1. **Define the outcome in terms of specific behavior.**—Let us assume that one general outcome which we are seeking to measure is the adoption of the scientific method of thought and action. Further, let us assume that we are proposing to measure development along this line at the later elementary and junior high school level.

The first question before us is to decide what specific behavior on the part of boys and girls would be a fair indication of the adoption of the scientific method. In other words, what would the child who has some control of the scientific method do that the child without such control would not do? Such a child will be characterized by suspended judgment. He will be unwilling to make generalizations until he is sure that he has all the facts that are available to him. He may make what adults call hypotheses but he holds these hypotheses tentative until he can verify one of them to his satisfaction. Such a child also will be sensitive to the problems of his environment. He will be able to perceive in situations the inconsistencies and coincidences that call for study and explanation. He will be forever asking why and how. Such a child will also be much more interested in discovering than in proving. The true scientist rarely endeavors to prove the truth of his preconceived notion but remains open-minded regarding the goal to which his work may lead him. These points illustrate the types of behavior which would differentiate the child who has progressed toward some control over scientific method from one who has made no such progress. Obviously, the definition of the outcome in the terms of specific behavior should be as comprehensive as possible and should include all significant types of behavior that are relevant.

At this stage also, it is desirable to have in mind appropriate levels of behavior to be sought. The test for scientific-mindedness should be different for second graders, sixth graders, and twelfth graders because

of their differences in maturity. Thus, sensitiveness to problems in governmental relations can scarcely be expected of second graders, but it may be proper to expect second graders to be sensitive to problems of room ventilation or of the need for adaptation of the rules of a game to make it fit the playground conditions better.

Another question of importance when defining the outcome sought is the extent of the sampling of behavior which may be required. This is particularly important when attempting to measure attainment of so-called general objectives, for most of these assume very extensive transfer. Thus, for example, we may seek to measure scientific-mindedness only in the science class and, therefore, define behavior in terms of the situations which may arise in the science class. We may, however, seek to measure scientific-mindedness as revealed in the response to all types of school situations that cut across conventional subject divisions. In this case, it is clear that the sampling of behavior must be much more extensive than in the former case.

2. **Arrange test situations in which this behavior may be observed.**—Perhaps the first thing to suggest here is that the testing not be limited exclusively to pencil and paper tests. The Character Education Inquiry,[6] and the evaluation program of the Progressive Education Association experimental schools[7] have found it necessary to go beyond pencil and paper tests in their effort to evaluate major outcomes of instruction. It is true that some of the measuring instruments developed in these inquiries are not practicable for use in regular public schools. Yet the fact remains that certain kinds of behavior, perhaps the most important kinds of behavior, are difficult to evaluate by pencil and paper tests alone.

In this connection, attention may be called to the anecdotal record[8] that has been developed principally in the Rochester Atheneum as a means of collecting information about the responses made by pupils in various situations as they arise. Such a record, although time-consuming, is of unquestioned value in getting and preserving objective data about children. Although such a record can scarcely be called a test, yet it provides information which supplements what may be obtained from tests.

As far as possible the testing situation should be so designed as to secure information directly about the outcome which is to be measured. For example, if we are seeking to measure the phase of scientific-mindedness that is called sensitiveness to problems, it will not do simply to have pupils give their judgment of the importance of being sensitive to

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[6] Hartshorne, Hugh; and May, Mark A. *Studies in Deceit.* Studies in the Nature of Character, Book I. The Macmillan Co., New York, 1928. 750 pp.

Hartshorne, Hugh; May, Mark A.; and Maller, Julius B. *Studies in Service and Self-Control.* Studies in the Nature of Character, Book II. The Macmillan Co., New York, 1929. 559 pp.

Hartshorne, Hugh; May, Mark A.; and Shuttleworth, Frank K. *Studies in the Organization of Character.* Studies in the Nature of Character, Book III. The Macmillan Co., New York, 1930. 503 pp.

[7] Tyler, Ralph W. "Defining and Measuring Objectives of Progressive Education." *Educational Record,* Supplement No. 9: 78-85, January, 1936.

[8] Randall, J. A. "The Anecdotal Behavior Journal." *Progressive Education* 13:21-6 January, 1936.

problems. The testing situation should array situations that actually involve problems that may be perceived by the alert, scientifically-minded pupil.

As in the case of measuring other and more specific abilities, it is desirable to plan the situation so as to eliminate or allow for factors other than the one which we are attempting to measure. To illustrate again, if we are testing the ability to sense problems in situations, steps should be taken to remove other difficulties and hindrances. Thus, difficulties in reading may be eliminated in part, at least, by allowing the pupils to read the material silently and also by having the examiner read it aloud so that there is reasonable assurance that all pupils understand the words. Similarly, if we are seeking to measure the degree to which pupils are able to withhold judgment until all the facts are in, we should use situations which are either entirely new or entirely familiar to all the children so that the facts available will be the same for all.

Another point to keep in mind in planning the test situation is the fact that it may be entirely proper to use specific details in a test even though it is not important to know any particular item in the list. Thus, for example, in our Detroit test of literature appreciation[9] we sought to measure the love of reading. We could devise no way of measuring this outcome directly and therefore acted on the assumption that love of reading would be highly correlated with extent of reading. We therefore devised a completion test, including 45 items, of which the following is a brief sample:

> "Before boys and girls have progressed far in the high school, they are likely to find that well-thumbed volumes such as (51) ———— Swift 'series' and (52) '———— Carlton's Year at Junior High' have begun to lose some of their charm. What an enormous range of books the young reader has to choose from! For sheer entertainment he can turn to the works of the popular (53) ———— Tarkington, to F. H. Burnett's sentimental 'The (54) ———— Garden,' or to the sketches of that master of modern slang, Ring W. (55) ————."

Surely the knowledge of the first name of Booth Tarkington is itself unimportant and the same statement may be made about the other individual items in this test. The fact remains, however, that the high school student who loves to read will probably have read widely and furthermore will know authors and books and magazines better than the student who does not love to read and who has not read so widely. Specific details may properly be used in a test to secure desired information even though they are not themselves particularly important.

It goes without saying that the test situation in measuring a so-called general objective should be as reliable as the test situation in more conventional areas. This means that the size of the sample of pupil behavior should be large enough so that the interpretation will not vary appreciably from one sample to another for the same child.

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[9] Rankin, Paul T., and others. *Detroit Literature Appreciation Test I.* Board of Education, Department of Research, Detroit, 1931.

3. **Provide for adequate records of the observed behavior.**—The chief idea I wish to suggest in this connection is that the actual record of behavior should be distinguished as far as possible from the interpretation of the record. This concept is particularly important when rating scales are used. It is also desirable to preserve the original record in cases like the evaluation of objective products of behavior such as samples of handwriting, drawing, or construction work. Too often in these cases the objective rating or evaluation of the product is preserved and the objective product itself is not retained. If the product is kept, it can be re-evaluated at any time.

One point about records needs no emphasis with a public school group—that the record must be simple and easy to handle. Elaborate schemes of recording behavior may be entirely appropriate in the experimental laboratory but must be simplified greatly to be useful in the typical public school.

4. **Evaluate the behavior.**—By evaluation is meant the comparison of the pupil's reaction with the reaction that is considered desirable or correct. Evaluation is particularly difficult when we deal with tests of general objectives for the reason that we have no recognized body of content that corresponds to the content of the established school subjects like arithmetic and spelling. What would constitute the correct answers in a test of sensitiveness to problems in a situation? Surely the answer is not the response made by average adults to the situation. Indeed, who can state all the problems that are implicit in a given situation and which may be seen by the most alert and scientifically-minded person? The question of evaluation in such a situation seems almost too difficult to solve, and yet if we are to measure children's growth along this line, we must have some basis of evaluation. The common procedure is to base the key on the judgment of many competent persons rather than on the judgment of one or a few.

5. **Interpret the results.**—The interpretation of the results of the measurement of general objectives is more difficult than the interpretation of the measurement of reading ability or other direct school accomplishments. General objectives, such as scientific-mindedness, or the attitude of coöperation, or the appreciation of democracy, reflect not only the teaching of the school but also many factors in the life of children outside the school. Of course, this is true to a degree also in the case of school activities like reading and spelling, but not nearly to the extent that applies in the case of the general objectives.

Another difficulty arises when the attempt is made to measure general objectives. Pupils, parents, and teachers all protest that the materials included in the test do not appear in the course of study. In the very nature of the case the general objectives cut across the separate subjects of the curriculum and are likely not to be taught very specifically. It is for this very reason that the instructional leader who genuinely cares to develop the so-called general objectives will use measuring instruments in this field in order to direct the attention of teachers and pupils to the importance of these objectives.

ILLUSTRATIVE APPLICATION OF PROCEDURE TO THE CARDINAL OBJECTIVES

Some time ago we attempted to develop a test of the degree to which secondary school pupils in Detroit had attained six of the seven cardinal objectives of secondary education. Control over fundamental tools was omitted because this ability was amply tested through other means. A further purpose in the development of the test was to make vivid and concrete to both teachers and pupils just what it is that the high school is set up to accomplish. The test was designed primarily for use in grades 7 through 12 but it was administered experimentally as far down as grade 3A. The test was prepared coöperatively[10] by a committee[11] of teachers and assistant principals together with a representative of the Department of Research, who served as chairman of the committee.

Distinction from usual tests and examinations.—In the first place, this test was designed to measure a wide variety of abilities and attitudes that were not assigned specifically to any one subject of the secondary school. This fact made the task more difficult for the majority of the members of the committee because the tendency always was to exclude items that were not formally taught in French or Chemistry or Household Arts or some other subject. Finally, however, the committee did agree that their task was to test attainment of the objectives even though the particular items included in the test might not be provided formally in the course of study for all pupils.

In the second place, the test measures knowledge, but very frequently as a means to another end. Thus, for example, one test item was as follows:

"The fastest of the following lenses is

(1)____f4.5 (2)____f5.6 (3)____f6.3 (4)____f7.9."

This item is included in the test on the assumption that students who can answer it correctly probably have more than usual interest in photography.

Content of the test.—The test includes 145 items in all, arranged in two parts, each of which requires 35 minutes for its administration. The test items are so arranged that separate scores may be secured for each of the six major objectives tested: citizenship, use of leisure, home membership, vocational preparation, health, and ethical character.

The first 22 items are designed to test the citizenship objective. They include knowledge items like exercises 6 and 13 quoted below and judgment items like exercises 14 and 19. The score on these items is the number right.

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[10] Irwin, Manley E.; and Rankin, Paul T. "The Coöperative Preparation of Improved Examinations." *School Review* 39:112-23, February, 1931.

[11] The committee consisted of C. H. Blanchard, J. K. Boltz, C. E. F. Clark, N. E. Craig, Lila E. Fyan, Katharine G. Hine, Ereminah D. Jarrard, Inez B. Jones, Dorothy M. Roehm, E. C. Thompson, J. G. Wolber, Mabel Woodward, and Paul T. Rankin, chairman.

6. Immigrants are always
(1)____foreign-born (2)____laborers
(3)____undesirables (4)____traitors

13. The gross annual budget of the city of Detroit is about
(1)____ 15 millions (2)____ 50 millions
(3)____150 millions (4)____625 millions

14. Assume that you know that a neighbor's child is suspected of having scarlet fever, but has no medical attention. What should you do?
(1)____Mind your own business and say nothing.
(2)____Tell the parents to get a physician.
(3)____Notify the city department of health.
(4)____Be careful to avoid the neighbor's family.

19. You wish to become an ideal adult citizen. Which would be most important for you to do as a good citizen?
(1)____Vote regularly.
(2)____Mind your own affairs.
(3)____Work to improve the community, the state, and the nation.
(4)____Learn the fundamentals of local, state, and national government.

The next 45 items are designed to test the wise use of leisure. Items 23-50 are planned to sample a wide range of interests—outdoor and indoor interests, fine arts and practical arts, games and sports, etc. Each item is planned to be easy enough so that some high school students will be able to answer it and hard enough so that only those students who had had considerable interest and experience in the special field will be successful with the item. Several illustrations follow:

25. Downstage means
(1)____toward audience (2)____away from audience
(3)____under the stage (4)____into the wings

26. Picot is a term used in
(1)____hunting (2)____card games
(3)____sewing (4)____handball

29. A city which has a team in the National League and also in the American League is
(1)____St. Louis (2)____Brooklyn
(3)____Cleveland (4)____Pittsburgh

41. "She Stoops to Conquer" is a
(1)____poem (2)____novel
(3)____play (4)____grand opera

47. "Century" is the name of a
(1)____movie (2)____racehorse
(3)____fishing bait (4)____magazine

The remainder of the section on leisure is designed to discover the degree to which students recognize the place in life of a wide variety of recreatory activities and also to measure their judgment of the relative importance of these diversified activities. The directions and several of the items follow as an illustration of this portion of the test.

DIRECTIONS FOR EXERCISES 51-67: Here is a list of activities in which many people engage. Consider each activity. If you think that the majority of people should spend some time on it during a year, underline "Yes"; if not, underline "No." After you have marked each item "Yes" or "No," then choose five, and only five, activities in which practically every person should engage regularly. Mark these by a check (√) in the blank before the item.

51. ___YES NO Attending movies
52. ___YES NO Dancing
55. ___YES NO Idleness
57. ___YES NO Listening to radio
60. ___YES NO Reading

This section of the test was scored in such a way as to give high credit to those who consider that most of the activities here merit some time from the majority of people. If 13 or more of the 17 items are answered "Yes," the perfect score of 5 is received; if 11 or 12 are checked, a score of 4 is received, etc. The five activities which were considered most important for practically everyone to engage in regularly are: exercise and sports, reading, hobbies, social activities, and church activities.

Home membership was tested by 20 multiple choice items, of which the following are reasonably representative:

68. The normal body temperature is
(1)___100° F. (2)___101.4° F.
(3)___98.6° F. (4)___96.8° F.

75. The bond of home life which should be the strongest is
(1)___affection (2)___economic relationship
(3)___protection (4)___education

87. While your parents are visiting, friends of theirs come to the house. You want to get away to see some of your own friends. You should
(1)___Tell visitors you are sorry your parents are not home.
(2)___Tell them you are just leaving.
(3)___Tell them to come again.
(4)___Invite them in and talk with them until parents return.

Vocational preparation was tested first in terms of knowledge items like the following:

97. A public accountant is a person who
(1)___examines bookkeeping records
(2)___keeps books
(3)___collects overdue bills
(4)___settles bankruptcy cases

98. The least training usually required to become a toolmaker is approximately
(1)___grade nine (2)___grade twelve
(3)___college (4)___college and professional school

103. The least training usually required to become a saleswoman is approximately
(1)___grade nine (2)___grade twelve
(3)___college (4)___college and professional school

105. In Detroit a milkman's (milk salesman) average weekly income while working is

(1)____below $35 (2)____$35-$50 (3)____$50-$65
(4)____$65-$100 (5)____over $100

The other portion of the test on vocational preparation was exercise 114, for which the directions and example are quoted:

DIRECTIONS FOR EXERCISE 114: Look at the list of occupations listed below. (1) Put a check mark before those occupations from which you now think you will eventually make your own choice. If your choices are not represented, write them on the blanks provided. (2) After completing the last direction, look at the list again. Draw a line through all of the occupations listed that you think do not add to the social well-being of the community.

Exercise 114

____Actor ____Lawyer
____Architect ____Locomotive engineer
____Artist ____Maid
____Athletic director ____Mechanic

This exercise was scored in two ways. First, a small number of checks was given high credit as indicative of the narrowing down of the vocational choices by the student. Second, a large number of cross-outs indicated a lack of appreciation of the social value of many occupations and therefore maximum credit was given to the minimum number of cross-outs. In passing, it may be remarked that 42 per cent of ninth grade students crossed out "garbage collector" as being an occupation that does not add to the social well-being of the community. It may be that these students misunderstood the directions. If not, they certainly fail to appreciate a most important occupation.

Health was tested by a number of multiple choice and true-false items, of which the following are fairly representative:

117. A disease against which almost perfect protection can be secured through proper treatment before exposure is

(1)____pneumonia (2)____tuberculosis
(3)____diphtheria (4)____mumps

128. If the teeth are to be cleaned only once a day, the cleaning should be done in the morning rather than in the evening ..... T F

132. A person's digestion of food depends very largely upon his emotional conditions during and after the meal.... T F

Ethical character was perhaps the most difficult objective to test at all adequately. The committee used two approaches. In the first place nine situations were presented with the direction to state what the person ought to do in these situations. No attempt was made to have the student state what he would do but rather what he should do. One exercise will be given as an illustration.

141. Assume that in taking record in the grade room at a vacant hour, you discover that a friend of yours is absent. What should you do?
(1)____Mark him absent.
(2)____Not mark him absent.
(3)____Tell him later that you will mark him absent if he does it again.
(4)____Ask to be relieved of your duty of taking record.

Finally it seemed desirable to include a test item in which character in action would be demonstrated. The Hartshorne and May modification of the Cady Squares Test was used. A perfect score was given if there was assurance that there was no cheating. A zero score was given on this item if the corners of the paths were turned correctly in too large a proportion of cases to be possible through chance.

Results.—Scores increased regularly but slightly from grade to grade. Of a possible score of 156, the 9B average was 90 and the 12A average was 110.

Items were classified as knowledge, judgment, and action items. The increase in action scores from grade 9 to grade 12 was appreciably less than the gain in knowledge and judgment scores.

On the modification of the Cady Squares Test, 65 per cent of the children did not cheat. There was a slight, though irregular, increase from 9B to 12A in the proportion not cheating. Boys were slightly superior to girls in this regard.

The test revealed a very general adoption of the attitude of favoring diverse ways of spending leisure. More than three-fourths of the 9A pupils stated that they thought the majority of adults should spend some time on 15 of the 17 activities suggested.

As usual, there was considerable concentration of vocational choices in the white-collar occupations. Thus, for example, 59 per cent of the girls said that stenography was one of the two or three occupations from which they expect to make their final choice. As a matter of fact, less than 2 per cent of women above the age of 20 years are engaged in the work of stenographers or typists.

The test revealed further a surprisingly small appreciation of the social utility of many specialized occupations. More than 25 per cent of 9A pupils crossed out as not adding to the social well-being of the community the following 6 of the 25 occupations listed: garbage collector, window trimmer, maid, actor, explorer, and baseball player.

Evaluation.—This test was admittedly imperfect and inadequate, although considerable time and thought were given by carefully chosen teachers to its construction. The test did have, however, several significant results. First, it aroused the attention of both teachers and pupils to the basic purposes of the secondary school. A number of teachers' meetings were devoted to ways of improving the teaching to achieve more surely these basic objectives; school papers carried series of articles concerning these objectives; and individual teachers used the opportunities in their classes to develop the objectives in their pupils. Second, the test gave an unprecedented opportunity to pupils to discover some of their own strengths and weaknesses with reference to these problems of education. Finally, the test yielded considerable incidental information of value concerning the effectiveness of school procedures.

SOME GENERAL SUGGESTIONS

Finally, may I offer some general suggestions regarding the measurement of major school objectives.

1. **Use varied approaches and not paper and pencil tests alone.**—The value of the anecdotal record has already been suggested. Where this plan is used, each teacher keeps what might be called a log of events; she makes brief notes of significant happenings with reference to each pupil. For some pupils, many items will be accumulated; for other pupils, very few items. But there will grow gradually a body of revealing information about individual children and their ways of meeting situations. Another approach is the use of rating scales of various types. Ratings by both teacher and pupils have their place. The Character Education Inquiry developed several such rating instruments that merit wider use. Rating schemes may be rendered more objective and more reliable where they are based largely on objective records of pupils' behavior like those preserved in the log or anecdotal record. A third approach is the use of actual classroom situations to discover the responses of class groups. Thus, for example, if courtesy is a school objective, a simple test situation may be set up by having the teacher excuse herself from her room for a time and then observing the responses of the children to persons entering the room. Another teacher may come in, or a new pupil, or a pupil from another room. How do children in the class treat these guests in their room?

2. **Take care to insure honesty and frankness in answering.**—When we endeavor to test general objectives, we must be alert to avoid situations in which pupils answer only what they think the examiner wants. For example, if we are investigating leisure time activities of children, we may not always get truthful replies to the question, "How often do you attend the movies?" Children are inclined to adapt their answer to what they think the teacher considers right. It may be better to approach the matter indirectly. Thus 50 names may be presented with the request that the pupils classify them as movie stars, athletes, or writers. The movie addict can then usually be detected by his ready identification of the movie actors.

Similarly, direct questions in regard to moral issues may not be as desirable as questions about the issue in general. Thus, children may be too inclined to answer "Yes" to the question, "Would you give back the extra money if a storekeeper gave you too much change by mistake?" It might be better to ask, "What should a person do who receives too much change from a storekeeper by mistake?"

3. **Use genuinely new situations in testing abilities other than knowledge alone.**—If a situation is used which is familiar to pupils, many will give the answer they have learned rather than the answer they have thought out for themselves. This principle is applicable especially to the testing of appreciation or of reasoning ability.

Consider, for example, a test of the ability to recognize good writing as an indication of literature appreciation. If passages are used that are familiar to pupils, their judgments of relative merit will be based

in part on what they remember that the book or the teacher said about the relative merit of the selections or of their authors. Is it not preferable to present selections that are totally new to all the pupils? Then the judgments reflect more surely a real power to recognize good quality of writing.

Or consider a test of literary appreciation in the form of a test of the ability to interpret correctly a literary selection. If a standard selection is used that has been read or studied by members of the class, their responses reflect partly their memory of what they had learned before and partly their ability to read and interpret. Is it not much better to use an entirely new passage, perhaps one that appears in no book with which the pupils come in contact?

CONCLUSION

In conclusion, then, may I urge that all of us school people apply the techniques of measurement not only to the knowledges and skills commonly tested but also to the basic general objectives of the school that seem to be of even greater importance. We all list such general goals as the major aims of the education. These goals are susceptible of measurement, although the process is admittedly difficult and time-consuming. There is ample evidence to support the view that outcomes that are measured are attained more surely and more adequately. Are not the general objectives of such great importance that we are obligated to take every means, including measurement, to insure their development in the children and youth who attend our schools?

The Time Factor in Learning

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ALL students of the subject of time are agreed that few topics have been studied more and have advanced less than those involving inquiry into the true nature of time. The subject has appealed to philosophers, psychologists, and mathematicians of all ages. No one can doubt that the subject, when conceived in a metaphysical way, is beset with enormous difficulties (9).[1]

In most of the early studies time is regarded as non-material, but it is usually given some sort of objective existence. Zeno and Aristotle seem to identify it with motion, while Newton, as we all know, gave time a thoroughly objective existence. The time factor is incorporated into his laws of motion and given special treatment in his mathematics. The modern theories of relativity have clashed somewhat with Newton's conception of time, but they still maintain for time an objective existence and have it play the rôle of a fourth element in a space-time continuum. They point out that the adequate determination of any event involves four coördinates or dimensions: three are furnished by space and one by time. Here time plays a rôle that cannot be taken over by space alone. It is necessary to observe this point (5).

These theoretical envisagements of time have their appeal to all of us, but the writer does not wish to hesitate longer than is necessary in the analysis of these labored details. He would like to point out, however, that in practically all psychological references to time, either of the theoretical or practical sort, a fatal error is made. This error involves the conceiving of time as always equivalent to empty space. That is, time is regarded merely as affording opportunity for truly causal things to happen. In this curious bit of unthinking, time is merely emptiness, nothing, just opportunity for something else. We see this notion in such a phrase as "give me time and I will do it." There is no thought here that time is an operator or contributor but rather that it provides space, in the sense of "elbow room." No factor has contributed more to the neglect of studies on the true contributions of time in psychology than this one. Practically the whole of present-day psychology is under the dominance of this error. The writer has referred to this elsewhere as the fallacy of the "nothingness of time" (8).

In the research just cited the attempt was made to show that actually time plays two rôles in mental growth. Early in the formation of any coördination, time plays a causal, operating, or contributing rôle; and later in the growth or development of the same coördination, time plays a passive, space-like, or "elbow-room" rôle. It can be said that learning is the actual passing of a coördination through these successive stages. In the case of the very small child the phrase, "give me time and I shall walk," has a wholly different meaning from the statement of a ten-year-old, "give me time to get my hat." Specifically, the difference

[1] Numbers refer to references at the close of the article.

resides in the complete variation in the rôle played by time in the two instances. In the first case time is actually a causal factor; it contributes to the growth called learning to walk, and this growth could not take place without time any more than a sand pile could settle without time. When fully settled, the sand pile represents a contribution of time; time is built into it. We say that this fully settled sand pile is old, that is, it has age, and we mean here to indicate the contribution of durational time, not elbow-room time. In the child learning to walk, the interpolation of time between successive efforts is actually incorporated into the growing coördination. Precisely as we saw in the case of the time contribution to the sand pile, we can now say of the child of five that his walking coördination has age. We should go even a bit further and say that part of his walking coördination is settling age, where the intent is to specify the contribution of time to coördination, exactly as we do say of the sand pile that its hardness is sand-pile age.

In the second case above, where the older child wishes time to get his hat, the passing of an adequate interval of time ordinarily plays no part in the execution of the coördination. There is here, instead, a net residual time-of-the-act which is time in the elbow-room or space-time sense. In all of our references to time, with either a physical or psychological meaning, it is necessary to maintain the distinctions we have seen above. The fourth dimension conception of time, as seen in modern relativity to which reference has been made, involves, in the writer's judgment, a most unfortunate fusing of these two very distinct aspects of time. Physicists who deal with the highly stable material world can get along in a fashion without a clear distinction here—they did so for hundreds of years before the birth of relativity—but for psychology and education, the distinction as to the two rôles of time must be made at the very beginning, since in all forms of mental growth it is in the early stages where the contribution of time as duration has its chief value. Psychology, on the whole, has either refused to recognize the dual rôle of time, as in the case of Woodworth, who specifically states that time can produce no effects (12), that is, he limits time to the second sense above, or it has presented a very confused picture, as in the case of the mental-age concept, or the half-hearted recognition of the positive rôle of time in such functions as the distribution of practice over time, or in the fixation of impressions by time where a blow may terminate the fixation process and produce retroactive amnesia. As a rule, psychologists are either vague in their references or are deeply opposed to recognizing the contribution of durational time to mental growth.

As an example of the determination with which writers reject the positive contribution of durational time and cling to the conception that time is merely elbow-room, we wish to refer to the researches of two capable and very serious workers in psychology. Lorge (4) and Brandt (1) have both provided experimental evidence of the positive rôle of time in learning, but both cling to the conception that time enhances the growth taking place by providing opportunity for other—to them—really causal factors to operate. In agreement with Woodworth they hold that time itself can produce no effects. Brandt, who studies associational learning, concludes that in the time-intervals between prac-

tices the subjects must *practice* or *rehearse* their material to be able to demonstrate a gain over these intervals. The observations of Lorge are also handled in such fashion as to exclude also the positive effect of time. One wonders what these observers would do with activities involving no insight whatsoever, where recall in the intervals is either not possible or not feasible since the subject does not know the factors contributing to the learning. In all of these efforts to throw aside the positive effect of durational time, the writer is reminded of the story of the miser who must hold his gold in his hands or have it rest on his body. He died of exhaustion! To him the possession of gold meant only to hold it in his hands or have it rest on his body. He could not possess without holding, without muscular tension. That one must be exercising across these temporal zones of emptiness to get rewards is still the belief of too many psychologists. This relic of an extreme behaviorism that sees cause only as stimulation and effect only as a motor response must be exhausting to its supporters. I can only wish them splendid endurance and the happy faculty of practicing on occasion, when no one is looking, what they do not preach.

Before we turn to the experimental material of this paper, some further consideration must be given the dual rôle of time. We have mentioned the durational or flow aspect of time and also its space-like character, and have pointed out that for psychology and education these two aspects must be considered as consecutive, that is, we must see that the durational or settling-sand-pile character of time is operative chiefly in the early stages of growth, and that later in the rise of coördinations time operates largely as an empty space-frame. It is undue emphasis upon the latter which leads to the space-time of relativity; and the exclusion of the former leads to the doctrine that time can have no effect, as seen in the work of Woodworth and his pupils. Further refinements, particularly in terminology, are very necessary.

When time acts as it does in the case of the sand pile it not only marks a flow but it also has a *stabilizing* function. The growing coördination of walking in the small child must be stabilized, and time produces this stability. The coördination is built up in its early stages largely through this process of stabilization. When a very unstable thing takes on stability we observe the gradual appearance of form, of constancy, of "thereness." Our very processes of perception involve this stabilization factor. In truth, the early stages of motor learning are given over to processes very similar to perceptual stabilization. If we were to observe the process of stabilization taking place in a cloud, for example, we would pass from a highly gaseous, spread-out state to a more *contracted*, less diffuse state. It is this same kind of contraction we have in mind when we say the sand pile has settled. Our perceptions of objects and our motor coördinations undergo the same sort of stabilization or contraction when measured against the frames of indirectly perceived backgrounds.

When we return to the scenes of our childhood we observe that the spacious old barn where the swing was, and even the trees we played under, appear to have contracted. This contraction cannot be explained, as some psychologists contend, by the fact that the observer has since

grown in stature—thus the barn appears smaller because we are larger—since it holds in cases where no growth in the height of the observer has taken place, and also holds if one lies flat on the earth and looks at the objects in such a way as to eliminate the effect of body stature. It is particularly evident from car windows where body height plays no part at all in the perception. The explanation resides in the fact that our perceptual processes have become stabilized by the passing of time and this carries for us the appearance of contraction in the objects we perceive. There is excellent psychology in the observation that difficult tasks loom large while mastered ones become little. An emotional state which blurs the total perceptual background enhances the appearance of contraction; thus the little child who has recited her "piece" at school stares in blank amazement when she is told that her task is finished. The coördination appears so contracted to her that she does not recognize the end. All early mental growth which is influenced so much by passing time is thus seen to involve this process of stabilization.

Let us suppose we were asked to provide an approach for a bridge which would resist the settling effect of time. This requirement, as we know, is exacted of highway engineers. But how would we go about the task of providing the approach? Is the task so difficult? By no means! We would build the approach high enough to allow for much settling before the bridge was to be used. And we would see to it that the approach was fenced off for months so as actually to provide for this settling. In other words, we would provide a structure where the settling effect of time already had reached a stage where further change would be of negligible or even of desirable proportions before the approach was used. That is, we would try to find in highway construction some principle, such as settling, that would always work in the same direction, and we would then take early advantage of that principle. Thus our bridge approach, instead of becoming useless, would become better and better as time passed. It is precisely this process of working with nature upon which both psychology and education must build. Suppose now we change the figure from highway engineering to mental growth and consider a request to design a learning process that will resist the ravages of time. What a request in a psychological world that cannot come to consider much but stimulus and response! Is the task impossible? The reader's answer here will be, I am sure, clear-cut and final. If there is a process in mental growth, you will say, that is a product of time in the first place, then we should weed out that process and build on it. In this event, time will serve merely to improve our foundation. As in the case of the bridge approach, it will grow and can grow only better and better. Our discussions thus far have indicated, perhaps, that there is such a growth process.

SOME EXPERIMENTAL CONSIDERATIONS

If we should undertake in a deliberate way to demonstrate a growth function that is manifest only at early stages of development, we would not be able to use ordinary activities of adult subjects, since we could expect to find in such cases that the activities had already passed be-

yond the point where these early processes could be observed, at least in striking fashion. One would need to employ little children as subjects or, what is better for college laboratories, to use learning devices which would reduce adults to the early level desired. The latter plan has much to commend it, and will be followed here.

Some years ago the writer presented some researches on mental growth (6, 7) which only recently have been found to involve a form of learning that seems to meet our present requirements quite satisfactorily. These studies employed what is commonly called "mirror tracing." Instead of the usual diagrams printed on cards and traced with pencils by mirror image, the writer has employed a more elaborate set-up. The principle is the same but the laboratory controls are far different. In our instrument the subject is provided with a niched path cut from sheet brass and mounted upon a smooth glass plate. This path is traced with a metal stylus, which actuates an electric counter when the sides of the path are touched. A full description of the instrument and details of its use can be found in the author's recent publication (8).

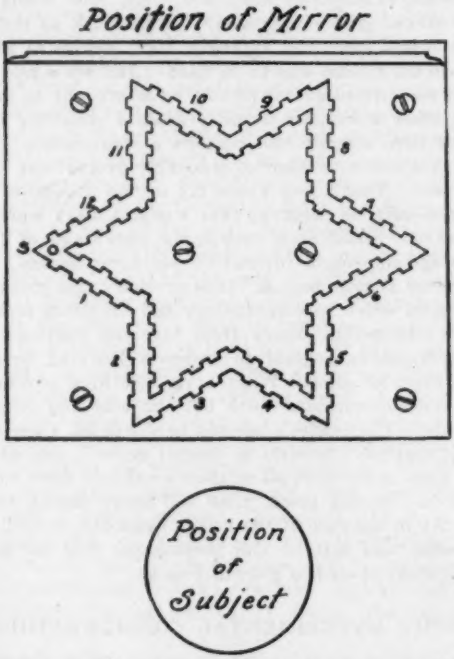

FIG. 1. This drawing shows the tracing instrument. The mirror is placed against the far side of the instrument and faces the subject. A screen is placed so as to make impossible direct vision of the path to be traced.

For us at the present time the most significance attaches to the fact that adult subjects are reduced to very early genetic levels by this device easily set up in experimental laboratories. The learning may be measured very easily and accurately. The time scores can be readily measured by a stop watch and the error factor by the electric counter. These time and error scores, which are inverse measures of efficiency since they decrease with increase of efficiency, can be transformed readily into positive velocity-per-second scores that represent efficiency directly. Figure 1 shows the general character of the tracing instrument.

If the reader will examine Figure 2 he will find a semi-diagrammatic graph showing two groups of subjects. The upper curve represents the efficiency scores of a superior group and the lower curve a group that begins with low efficiency. In fact a large group of subjects is sectioned into two parts by arranging the first scores in serial order. Note that in the early part of the learning the individual differences are decreasing and later, for the very same subjects, individual differences are increasing. In the left half of the graph the poorer the individual is at the start the more he gains, while in the right half of the graph the reverse is true. It is perfectly obvious that in the early part of the learning the subject is building up a base that is to be used later. It is in the building of this base where the low subjects make the greater gain. As soon as the base can carry a load it begins to earn increment in terms of its size, very much as in the case of interest which, with rate constant, varies directly as the size of the base. Thus there are two distinct processes taking place: one involves building up a base, and the other, the use of a base which has been built up.

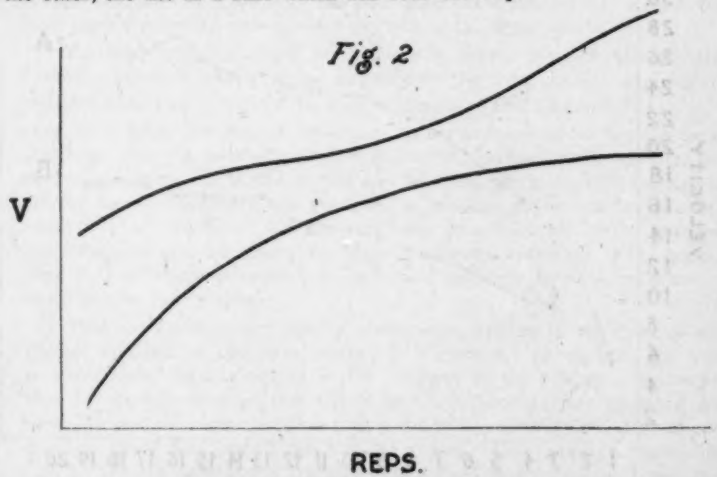

FIG. 2. A semi-diagrammatic drawing showing the velocity (V) or efficiency scores of two groups of subjects, vertical ordinate, plotted against the repetitions. Subjects were divided into two groups according to size of initial score. Note that individual differences are decreasing early and increasing later in the learning.

Another point is of the very greatest consequence. The author has shown (8) that time interpolated between repetitions enormously facilitates this process of base making. It was also shown in the same research that the longer the time interpolated, the greater the growth here; it may be regarded as a positive mathematical function of the amount of interpolated time. But in the right half of the graph the scene is changed right about, since here the time—beyond the amount of it required for the coördination itself—is a detriment and produces a loss. It will be seen at once that we have here examples of the two distinct rôles played by time: in the first, time was playing the part of a stabilizer and is a positive contribution to the learning; while in the second, time is assuming only its space-like or elbow-room rôle and any excess of it is a disadvantage.

There is yet another point which merits our attention before we leave Figure 2. When care is taken to observe the early effect of interpolated time upon different levels of ability we see that the lower the subject, the more he profits from the interpolated time. That is, this low subject is younger, farther to the left in our graph; he profits from interpolated time just in proportion as his coördination is young or low in the efficiency scale, which applies but less noticeably to the superior subjects as well as to the low ones. From such considerations one can see very readily that the experimental findings discussed here are logically consistent throughout. If the writer were in error about the two distinct

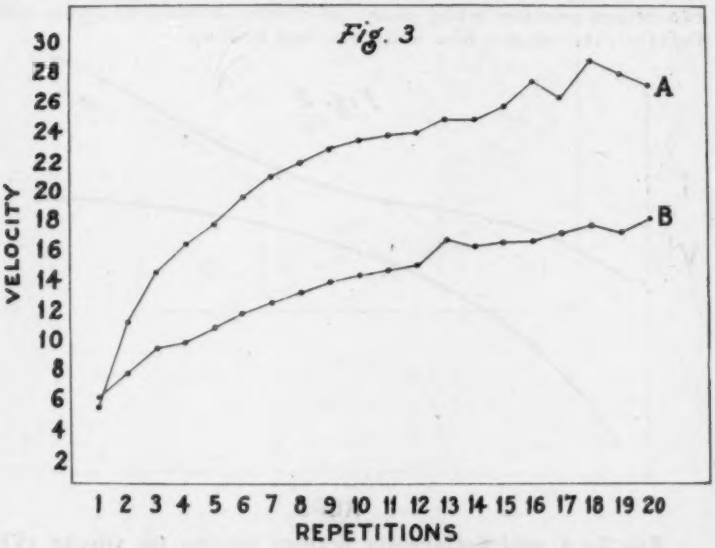

FIG. 3. Two curves showing the efficiency of subjects under time-interval practice A, and continuous practice B. There were 70 adult subjects in each group. The B group is initially superior.

rôles played by time the experimental findings would be difficult if not impossible to explain. Early growth is seen to be maturational in character; and such growth is actually reducible to a *coördination-age*, precisely as certain definite early-formed coördinations can be brought together and used as a scale for measuring mental age. There is, of course, a difference in application here, since our coördination-age refers to the actual time-age of a particular coördination, while the term "mental age" refers, generally, to a somewhat vague but general status of the individual subject.

Let us now turn to Figure 3. Here we see two curves plotted from the efficiency scores of two groups of adult subjects. There were 70 university students in each group. The curve marked A was plotted from the average scores of the group that made one repetition of the tracing instrument per day, that is, the interval of time interpolated between repetitions was twenty-four hours. In the curve marked B, we have the average scores of a group of initially superior subjects who made continuous repetitions of the instrument, that is, no time was interpolated between repetitions. It will be seen at once that the group with the interpolated time is far superior, within a very few repetitions, to the continuous-practice group. Time is clearly playing a positive or constructive rôle here. The low group is held down to abnormally low scores at a time when fatigue is not operating at all, since the differences are large early in the function, before fatigue could be producing any effect. It is perfectly obvious that the A group is indicating a growth which is denied the B group. But the only difference between the conditions for the two groups is the time-interval in group A. Hence, the interval is producing this greater growth in the upper curve.

To those with statistical inclinations it should be said that the differences between the average scores for the two groups are highly reliable and thus could not be due to chance. The reliability $\left(\frac{D}{\sigma_{diff}}\right)$ runs from 5, at the second repetition, to an average of 10 for the later stations. Since a reliability of 3 is statistical certainty, we see that the very first chance the time-interval had to bring about its effect—that is, on the second repetition—it produced a reliable difference for the two conditions of practice. By the time the fourth repetition is reached, the difference is more than three times statistical certainty, which means that if this difference were only one-third as large as it is, we know it could not be due to chance.

There is another, but wholly unexpected, finding in the further statistical analysis of the data plotted in Figure 3. If we take the time to investigate the variability of the subjects in the two groups, we see that in the initial repetition the B group is slightly less variable, but upon the second repetition this group jumps to a variability 40 per cent greater than that shown by the A group. This greater variability $\left(\frac{\sigma}{Mn}\right)$ for the continuous-practice group rises to more than 70 per cent greater than that found in the time-interval group, and then gradually recedes to an average of 40 per cent above that of the superior group. This last point must mean that time, which is given only grudgingly to the continuous-practice subjects—as they require it in practice—

eventually reduces their variability. The whole setting must certainly mean that the group under conditions of continuous practice is suffering early from the shock-effect of stimulation. This effect is relatively greater for the lower subjects than for the higher; thus the variability of the group is increased. We see also that this shock-effect of stimulation is mitigated by the time-intervals in the case of the A group, which gives us direct evidence as to why the time-interval is so valuable for these subjects.

It is a matter of the very greatest importance to note that the large growth in the time-interval group occurs at those points where individual differences are relatively so great in the continuous-practice group. If we say—and we certainly would say—that the shock-effect of stimulation is making these subjects unstable, then we must also say that the effect of interpolated time is to stabilize the superior group with whom the continuous-practice subjects are compared. But the superiority of the time-interval group is a growth process, as we have demonstrated in the growth curves, which leads us to the very important conclusion that *stabilization is a growth process* also. It is actually that process of growth, like the settling of a sand pile, which is brought about by interpolated time. We see, then, that this stability which grows, which involves a decrease in individual differences, is precisely the sort of thing which could underlie the later growth of the coördination. The later function, as we saw in Figure 2, varies directly as the scores already built up, which means that those who have built up large amounts of stability have larger increments coming to them when they push forward into the stimulation later. They were first building a base and later were making use of it. The situation now is comparable to the relation existing between principle or base and interest return: the larger the base the larger the interest return. But we must not forget that the base in our experiment is a growth affair and is largely dependent upon the interpolation of time between stimulations. Also during this primary growth, where time is playing its primary rôle, we must keep in mind that individual differences are decreasing and that this bringing of high and low together is greatly enhanced by interpolating time.

As we consider further the details of Figure 3 it will be apparent that while we are statistically certain that the time interval is lifting the efficiency of the A group to a reliable extent, yet we do not know how far below the time-interval group, A, the continuous-practice group, B, actually falls. It would be helpful if we could get more information on this point. To provide a standard of low ability from which to judge the level of the adult continuous-practice group, the writer has studied the efficiency of a group of 25 normal eight-year-old children in a nearby public school. The purpose here was to get a normal level of functioning at a point where the maturation factor would certainly be far below that of the mature college student. To make the results truly significant the children were given the same time-interval practice as we gave group A, that is, one repetition per day. The results are shown in Figure 4, where the data of the children are shown in curve C, the other two groups retaining the same letters as before.

The children are gaining on the adult, time-interval group and both

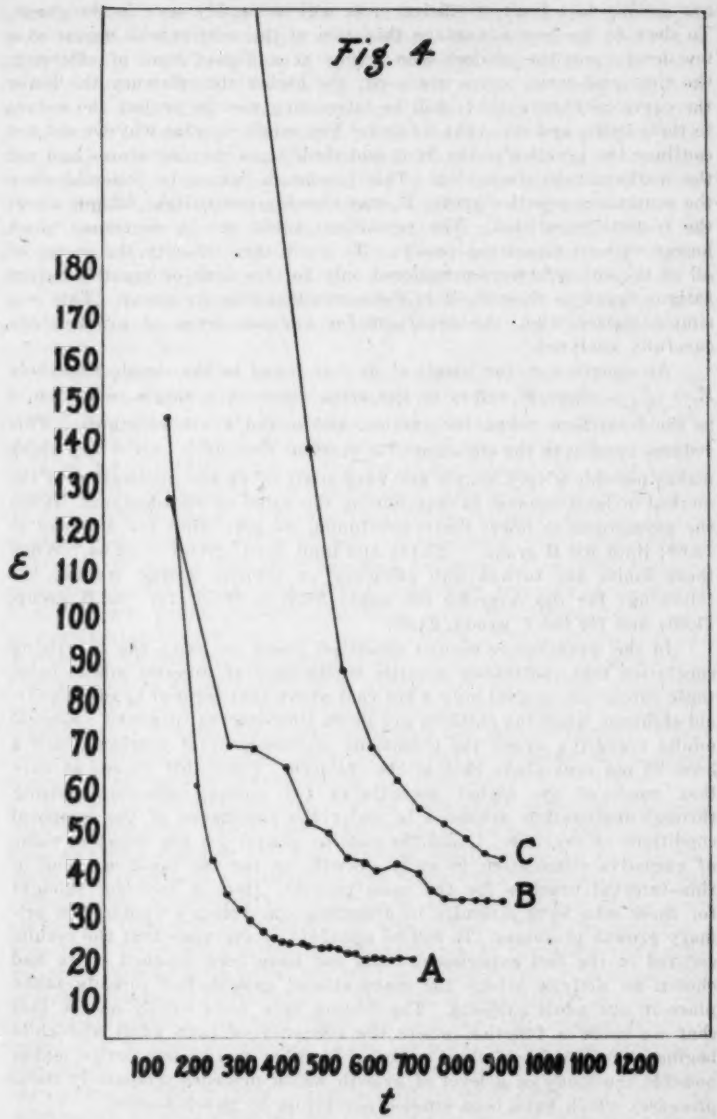

FIG. 4. Showing the error scores, vertical ordinate, plotted against the total time for the two adult groups and one group of children. A is the adult 24-hour, B is the adult continuous-practice, C is the children 24-hour interval.

are moving to a limit of efficiency, as will be readily seen in the graph. To show to the best advantage this gain of the subject who begins at a low level upon the subject who begins at a higher level of efficiency, the time and error scores are used; the higher the efficiency the lower the curve in Figure 4. It will be interesting now to project the curves to their limits and see what we find. You might wonder why we did not continue the practice to the limit and simply use the raw scores and not the mathematical projection. This procedure cannot be followed since the continuous-practice group, B, was showing some slight fatigue about the fortieth repetition. The repetitions could not be continued much longer without disastrous results. To avoid this difficulty the scores of all of the subjects were considered only for the zone of practice before fatigue began to show itself in the continuous-practice group. This is a simple matter when the equations for varying zones of practice are carefully analyzed.

An equation giving excellent fit was found in the simple hyperbola $E = \frac{t}{a + bt}$, where E refers to the error score of a single repetition, t to the total time taken in practice, and a and b are constants. This reduces readily to the equation of a straight line, as $\frac{t}{E} = a + bt$, which makes possible a very simple and easy study of fit and application of the method of least squares in determining the value of the constants. When the asymptotes or lower limits are found, we get: limit for A group = 13.68; limit for B group = 23.14; and limit for C group = 23.64. When these limits are turned into efficiency or velocity scores, we get the following: for the A group the upper limit is 36.55; for the B group, 21.60; and for the C group, 21.10.

In the quantitative results described above we reach the surprising conclusion that continuous practice in the case of superior adults holds these subjects to a level only 2 per cent above that secured by eight-year-old children, when the children are given time-interval practice. Normal adults operating under the conditions of time-interval practice reach a level 73 per cent above that of the children. From this we see at once that much of the higher potentiality for gaining efficiency arising through maturation processes is under the dominance of the temporal conditions of practice. Could the case be clearer for the negative value of excessive stimulation in early growth, or for the positive value of time-interval practice for the same period? Here is food for thought for those who have difficulty in accepting the author's findings on primary growth processes. It will be apparent to everyone that the results secured in the last experiment could not have been reached if we had chosen an activity where the maturational growth had already taken place in our adult subjects. The finding here rests wholly on the fact that we chose a function where the efficiency of both adult and child begins at points fairly close to zero. In other words, our device makes possible the study of a level of growth which precedes temporally those processes which have been studied heretofore by psychologists.

The reader must certainly have asked himself throughout this discussion why psychology has been delayed so long in coming to recognize these very simple principles set forth above. The answer is very simple. We did not go back early enough in our study of coördinations to see the

primary rôle of time. As we have just shown, the situation is reversed when we reach the later stages of learning. Recognition of what takes place later could never have given us insight into what takes place earlier. We like always to use the simplest frame of thought that is possible, and knowing what takes place late rather well, and in the main rather accurately, we simply project back to the beginning what we found to be so true later. However, another factor has played an enormous part in delaying our insight into the true nature of learning. I refer to the fact that we have always regarded the term *stability* as though we understood it. We do not! Stability is not an absolute thing but a wholly relative matter, a growth process. That is, it is not an entity or thing which can be taken on or off like a glove. We build it up. We know it is there only by the contribution it can make, as brought out in the paragraph above; it acts as principle or base, but this base is a growth over time.

If a child is nervous and thus poorly adapted to a specific stimulus-situation, his teacher says, "Johnny, be still." Did she understand stability? She did not, since she imagines that all Johnny needs to do is to *assume* stability. If the stimulus-situation is too exciting for Johnny's stability level she might try taking the stimulus away for a while and then bringing it back, and if this "broken practice" is continued for a time she will be surprised to find that Johnny is now still; he is now adapted. If this teacher is of the ordinary type the last thing she will come to see is that time has had anything to do with Johnny's *stability*. To her, and to psychologists generally, learning is adaptation to stimulation, but they understand this to mean that adaptation is some mysterious selection process or other involvement taking place in and during the process of stimulation itself. It is not so. Adaptation or rise of stability in an organism is on the "rebound" after stimulation and is akin to a kind of aloofness established as a contribution of the organism. It is Johnny's contribution and not the contribution of the teacher or of the stimulation, although it is not independent of the stimulus and is, in truth, an adaptation to the stimulus.

Do we in life away from the school understand stability any better than the teacher? We do not, and it should be said that there is a kind mother insight in the good teacher which saves the day for the child. She practices a little more and better than she preaches in this regard. She is sensitive to the flinching and nervousness of the over-stimulated child and often withholds stimulation. Thus she practices a philosophy which she does not preach, as a rule. In life where the mother insight is lacking there is but one law: stimulation first, stimulation last, and the organism's contribution is survival of the fittest. We are completely adjusted in this country to the fact that our leading theory of learning is a direct descendant of the biological principle of survival of the fittest. Our practice is to overstimulate men until they break and then stupidly confine them in institutions for safekeeping. In this hospitalization there is some belated insight into the fact that overstimulation had something to do with the break, since there is some effort here to remove the pressure of stimulation. We provide long intervals of rest completely removed from exciting stimulations. If we understood sta-

bility better we would see that it is a growth which arises from presenting the stimulus, then taking the stimulus away by interpolating time, then introducing the stimulus again, and so on, until the required stability has developed. The average patient in a state mental hospital has been taken completely away from the situation to which he *did* not adapt. This adaptation will never be built up by him since general insight into stability as a growth process does not exist; the recoveries are largely happy accidents. Our social and educational philosophies still rest very largely on the survival-of-the-fittest logic: if one is not elected to survive, the fates—only the fates, you see—have been unkind to him.

If one turns to learning theories he sees at every turn the dominance of selection and survival-of-the-fittest conceptions. Thorndike's theory is perhaps most widely known and will be discussed here for that reason. He employs the general biological setting provided by Herbert Spencer. Instead of random animate forms, as in biological theory, we have random movements. These are not shocked out of the organism by pressure of a new stimulus-situation; they are simply random, and further inquiry is not invited. Some of these random movements "fit"—from the principles of variability and randomness—and these are granted privilege to remain and were even "stamped in" in an earlier version of the theory. The feeling effect produced in the organism by the adaptive or maladaptive character of the random movement has much to do with the process of selection. If the king is pleased the movement stays; if not, the movement is eliminated. Here again inquiry into how a feeling state could perform this selection miracle is not invited.

Individual differences are initially in the lap of the gods in Thorndike's theory, which follows directly from his unwillingness to structure his conception of random movements. Superior subjects have either more good random movements or less of the poor sort, or the superior subject manages to provide more selective feeling effects, or something similar. The details, of course, must be somewhat disappointing in any theory which attempts to build an increment or growth process upon an unanalyzable or merely postulated selection of accidents.

Thorndike's theory is clearly a stimulus-response theory. The contribution of the organism to the learning process is not apparent at any point. Randomness and the survival of the fit dominate the entire conception. Yet, strange as it may seem, the Thorndike theory is open to criticism by the present author at only one point—the point of beginning. If one goes over very carefully the many brilliant quantitative and statistical studies of Thorndike, he will find nowhere any confirmation of his survival-of-the-fittest doctrine. To adopt the figure of Aristotle, one can say that Thorndike's clear-cut physics is beyond criticism; the difficulty resides only in his *metaphysics*. In those regions beyond his actual experimental setting Thorndike attempted to steer his course by turning to a popular form of biological metaphysics. The survival-of-the-fittest conception, not as an observation of an actual occurrence in nature which is everywhere in evidence, but as an explanation of the process of evolution, may still be without convincing support. But admitting the rôle of selection in biological philosophy, which ought to be a matter for the

biologists themselves to decide, anyway, we still have an enormous gap to bridge in our attempt to bring biological selection of animal forms to the same logical frame as selection of random movements in a living organism. I insist the only common elements are the words we have used to describe the scenes. The moment one lays aside the metaphysics of the selectionist in psychology and studies the actual state of affairs at the beginning of learning, as we have attempted to do here, he sees at once the utter hopelessness of the survival-of-the-fittest logic as applied to learning. Casting aside the metaphysics of selection which is completely discredited by the work of Lashley (3) and that of the workers in Gestalt psychology (11), as well as our own studies, one still has the whole of the actual experimental findings of Thorndike and many other selectionists.

I wish to make it perfectly clear to the reader that the references above must not be regarded as a wholesale criticism of such a splendid contribution to learning as that of Thorndike. The facts are that the principle of selection is perfectly true for late levels of learning, precisely as survival is true for adults in the business world. These growth levels involve increments of a particular sort and are actually processes of differentiation under pressure conditions. It can also be shown very readily that these late levels of growth reduce at once to increase in speed of functioning. The law of survival-of-the-fittest applies here with perfect certainty. Thorndike and other workers in the field are in error only to the extent that they have failed to see an *earlier* process in mental growth, one which lies not in a stimulational or pressure frame, but in a time frame. Our educational system has made the same error and we have been saved only by the mother insight of our good teachers. To be sure, our conception of learning must be entirely revamped. One cannot leave out of account those processes which contribute to foundation making and come out with a satisfactory superstructure. Had the error been made at the other end of the time sequence, one might neglect the findings of the writer with reasonable safety, but this is clearly not the case.

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Language and the Educational Program (Abstract)

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THE ability to control the muscles which produce articulate sounds is developed in the individual in much the same way that handwriting movements are developed. That language is not inherited appears in the fact that a child always acquires the modes of pronunciation and the vocabulary of those who are about him. A child of American parents acquires the language of his social environment, whatever this environment is. In other words, language as a fully evolved social art determines the development of speech in the individual.

Beyond the early acquisition of ability to use words there is a long series of developments in the course of which the whole mental life of the individual centers around words as the chief means of carrying on thinking. The educational process is dependent on language. It not only uses language as a means of communication; it helps the individual through training in the use of words to advance from the lower levels of mental activity to the highest forms of intellection.

Children begin the use of words by employing nouns almost exclusively. If one counts the different parts of speech in the dictionaries one finds that the vocabulary there recorded is also made up predominantly of nouns. A noun is a device for concentrating attention on an object or on a specifically distinguished element of experience. The fact that nouns are numerically the most common elements of the language is directly related to the fact that human adjustments have to be made to a great variety of things and recognizable situations.

When language takes the form of narrative or of scientific discussion, nouns constitute a much less important part of the discourse than they do of the total vocabulary as recorded in the dictionary. In narrative and scientific discussion the number of nouns is less than 25 per cent of all the words, while in the dictionaries the number of nouns is more than 50 per cent of all the words. In discourse relational words appear as of great importance. Although relational words, such as prepositions and conjunctions, are comparatively few in the language, they constitute a highly important part of the vocabulary of discourse. A striking demonstration of this fact is that the first 50 words in Ayres' spelling scale, which is based, it will be remembered, on frequency of use, do not include a single noun but do include a number of relational words.

Children acquire relational words slowly and use them sparingly. The sentences which children use in the lower grades are simple. All these genetic facts indicate the importance of emphasizing in the education of pupils the use of language beyond the mere stage of early articulation and early use of nouns. Relational thinking and complex processes of thought are dependent on the acquisition of words and modes of expression which are different from those which appear in the first stages of mental development.

The Difficulty of Acquiring a Social Mode of Behavior (Abstract)

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SUCH a form of muscular activity as that involved in handwriting is, from the point of view of the individual, artificial. Through long ages men have been engaged in perfecting the alphabet and in inventing writing materials and writing instruments which make the modern forms of penmanship possible.

The alphabet developed out of picture records. The most radical of the steps taken in the evolution of the alphabet was that of relating graphic symbols to sounds, thus abandoning altogether the effort to depict ideas directly and using simplified drawings as devices for calling to mind words which had been earlier developed in spoken language.

The earliest pictures and the earliest forms of written records were made on materials and with instruments that are very different from the paper and pencils and pens employed in modern times.

So remote from anything that the individual can invent or can naturally produce are the movements required in writing that each learner who tries to acquire the art of writing exhibits in his first efforts an utterly unorganized form of muscular activity. There is no inherited neural center which impels the individual to write or coördinate the muscles employed. Writing is in no sense instinctive. The unorganized character of the first efforts to write appears in the diffusion of the neural impulses which are sent out from the learner's nervous system. The little child, when he begins to write, grasps the pen with excessive force and contracts the muscles of the face, trunk, and legs, thus showing that the nervous system has no pattern of organized control over the writing muscles.

Selection of the appropriate forms of behavior is effected by a long process of trial and partial success. The learner sees the lines which are produced by his diffuse movements and is gratified when these lines conform in some measure with the social pattern set for him to imitate. Since satisfaction can result only from muscular contractions which include the elements essential to successful imitation of the social pattern and since the nonessential muscular contractions which are produced by diffusion do not contribute to satisfaction, a graduate process of organization goes on in the neural centers which control behavior. Successful behavior ultimately involves both elimination of nonessential contractions and coördination of those contractions which are retained because they are essential to success.

The transition from diffuse movements to coördinated movements is a long process requiring a change in the inner structure of the individual which can properly be described as a development of a social mode of behavior. The formula of "conditioning" is wholly inadequate. Writing is not a modified reflex; it is not in any sense an inherited

form of action. It is a highly developed form of behavior attained through imitation.

The example here discussed in some detail supplies the formula which is to be used in the psychological explanation of all the higher skills. Education in so far as it promotes the cultivation of the higher skills is dealing not with inherited traits but with forms of behavior in which the individual rises through the aid of society to a level of adjustment to the world which is impossible through purely individual effort.

Measuring the Budgetary Needs of the School System

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IN order to understand how to measure the budgetary needs of a school system, we should first know and understand the meaning of "budget" and its many ramifications. In England the House of Commons considered the budget as a document that contained the receipts and expenditures of the government. It was not until 1921 that America became interested in the term sufficiently to give serious thought to it. The United States government prepared a budget in 1921, and since that time it has grown and developed as an integral part of every political subdivision of local, state, and national government. It is in reality the measuring stick by which we decide our expenditures during a given period. W. G. Reeder, in his book *The Fundamentals of Public School Administration*, states that "a budget is a systematized statement which forecasts the probable expenditures and anticipated revenues of an individual, an organization, or an institution during a stated period of time." Another definition is given by A. E. Buck in his book *Budget Making*: "The budget in the strict sense of that term is a complete financial plan for a definite period which is based upon careful estimates, both of expenditure needs and of probable income of the government." With this elementary view of the budget, let us turn our attention to the budgetary procedure of a school system.

There are, in reality, two types of budgets that school administrators should consider: (1) the short-term budget, which usually covers a period of twelve months; and (2) the long-term budget, which covers a period of many years. In considering the short-term budget, a long-term budget should be kept constantly in mind. If the long-term budget is properly prepared, the short-term budget will be comparatively easy to justify. We, in Indiana, have concerned ourselves to a large extent with the short-term budget. We think in terms of from August 1 to July 31, whereas we should be concerning ourselves with at least a five-year period and should build to the program that is most desirable for an adequate educational program in each particular community.

In Indiana the problem for many years has been that property owners have had to carry most of the burden of taxation. This is not altogether true at the present time, because there have been revisions made in the taxing program of public education in this state. About five years ago the larger communities in Indiana were securing approximately 95 per cent of their revenue from local property owners. Five per cent was received from the state and federal governments, but only a very small part of this was paid by the federal government. Today the larger communities are receiving from 25 per cent to 30 per cent of their revenue from the state, a small part of which is furnished by the federal government through the Smith-Hughes Act and the Smith-Lever

Act. Indiana has revised its tax program and has in the main prevented many rural schools and some towns from having to curtail the educational program to a dangerous point. It is my belief that within a few years the state will be compelled to furnish at least 50 per cent of the revenue for the operation of schools in the state. If this situation does not come to pass, then it will be incumbent upon the federal government to aid in the education of the people of this nation. We hesitate to ask for federal support, because we feel that with it will come federal control. If in the end we are to accept federal support, the thing we will need to do will be to demand a minimum of federal control. Prior to the Morrill Act of 1862, there were certain grants given to public schools by the federal government where little or no control was exercised. Since that time, however, federal support has been more or less synonymous with federal control, and in granting money to the states for educational purposes the local community, as well as the state, had lost to a certain extent its autonomy.

The ideal school budget contains three parts: (1) the work plan, (2) the spending plan, and (3) the financing plan. The work plan is a definite statement of the educational policy and program. In an ideal school system the work plan should involve all the factors that enter into an adequate educational program for the children of that particular community. The education of these children should be the first concern in developing the work plan. The spending plan is a translation of the accepted policies to a proposed expenditure. It is therefore dependent upon the work plan. If the budget is properly prepared from an educational point of view, there should be very little money left at the end of a fiscal period. There are certain contingencies that must be provided for in the budget, and of course a part of this account may be left intact at the end of the fiscal period. The financing plan proposes means for meeting the cost of carrying out the educational program. School administrators who are working with public school finance know full well the problem of raising revenue to meet anticipated educational expenditures.

While I have laid great stress on adequate education and a definite educational policy for the preparation of the budget, there are certain limitations which must be taken into consideration. An educational philosophy should be the outcome of a well-prepared school budget. The budget itself should reflect the attitude of the community with respect to school expenditures. Frequently we concern ourselves with economy in school budgeting and forget about the educational needs of the child. The budget may be balanced financially but unbalanced educationally. I share the view of those who feel that a definite program and educational policy should be set up as the measurement of the school budgetary needs and that the idea that this policy is sound and basic should be sold to the community. I do not share the view of certain boards of education that say to the superintendent: "We have a certain appropriation. You must stay within those limits, and there is no possibility of securing any increases for this particular school year." The educational, or work, plan of the school budget should be given priority over the spend-

ing plan and the financing plan. This leads me to one further point before I go into the various factors that make up the budget.

"Budget-makers" is a name that has been given to those who have had charge of preparing school budgets. In the past, this phrase has perhaps been appropriate because budget-makers were concerned with two factors—securing revenue and allocating expenditures. It was necessary for those who had charge of the budget to make a budget each year prior to the time when it was to be presented to the board of education for acceptance. It was the usual thing to prepare a budget in two or three weeks' time. Budget-makers were not concerned with a long-term educational program.

Today we have a different attitude which, in my belief, is a new and more adequate philosophy of budget preparation. Those who are in charge of preparing the budget are budget-builders and not budget-makers. A budget is built by and through the development of the educational plan. It is a result of the educational plan and not an instrument to direct the policies of that particular school system. Therefore I say to school administrators that we need to be concerned about this thing we call the school budget. It is the sacred oracle that needs to be put in the sanctuary of our thinking and cherished by all school administrators. It is the heart of this great institution, the public school system. If it does not operate smoothly, many ills will result. No school today can operate without a budget. No school can operate efficiently without a well-developed school budget. I cannot lay too great an emphasis upon the importance of the school budget, and I beg of you to know and understand it, to impart that understanding to the teachers, to the parents, and to the taxpayers alike in your respective communities. People are concerned about the education of their children. They desire to improve the education of their children. You, as school administrators, are not fair to the community in which you live if you do not help the people who reside therein to understand intelligently the complete educational program involved in the school budget.

The functions of the school budget are many. It is a facilitating device for educating the child. The school does not exist in order to serve a budget; the budget is the servant and education is the master. The budget functions directly in giving the school officials an overview of the entire school system. A well-developed system of building and administering the budget leads toward coöperation within the school. Where the public is not giving the school adequate financial support, a well-developed budget may stimulate taxpayers to increased confidence in the sperintendent and in the board of education. A complete budget contains a balanced program of receipts. It aids in administering the school economically. Without a doubt it improves accounting procedure. Last, but not least, it projects the school into the future. By planning ahead for a period of twelve months the budget calls for extensive forecasting. It is not merely a financial forecast; it involves a forward look in building programs and other educational facilities.

One of the first things to be considered in the preparation of a school budget is the function which the school is expected to render in a given community. The educational program is, therefore, the first

part of the budget to be considered. To evaluate or to measure the budgetary needs, we need to peruse the issues involved in developing the educational program. These issues, therefore, become the measurement of the budgetary needs. There are ten issues that determine the educational program, and at the same time guide the budget-builder in measuring the needs for his school system. I will explain each issue with the view of helping the small school systems as well as the larger ones.

1. To what governing body must the school budget be presented? In Indiana the township trustees are responsible for the preparation of the school budget. Each trustee, of course, is expected to present his budgetary needs, whether it be for schools or for something else, to his advisory board. This budget is then presented to a county tax adjustment board for further consideration, and it is finally presented to the state tax board for approval. In towns and smaller cities the superintendent of the public schools, who in the main has charge of preparing the budget, is responsible to his school board. The school board in turn is required to submit the budget to the city council. The city council must then justify the budget to the county tax adjustment board, and it is then passed on to the state tax board for final approval. The larger cities follow about the same procedure in submitting their budget for approval. The business administrator, together with the school superintendent, usually prepares the budget for adoption by the board of education. This budget is presented to the county tax adjustment board and is finally approved by the state tax board. It is important for those who have charge of preparing the budget to study and inform the approving bodies with respect to the educational program involved in the budget. As I have said before, it is desirable, yes, necessary for the community to have an educational philosophy in order to understand fully the needs requested by those who have charge of the school budget.

2. What should be the length of the school term? The educational plan of the school should indicate the length of term necessary to impart the program to the children. The budget-builder should know whether the school term is to be 28 weeks, 32 weeks, 36 weeks, or 40 weeks in length. After having definitely established the length of the school term, preparation of the budget may be done accurately and definitely along a scheduled plan.

3. What type or types of school organization should be supported by the school budget? In the rural areas, and particularly the consolidated schools, it may be necessary to have the entire school program in one building. In certain other localities the 6-6 plan may be advantageous; then in the smaller towns and cities the 8-4 plan or the 6-3-3 plan may be most desirable. Consideration should be given to kindergartens, nursery schools, postgraduate work, and special schools. The type of school organization has a direct bearing upon the needs of the school system and should be determined in advance before consideration be given to budget preparation. The type of school organization will enable school administrators and boards of education to determine the type of school building, the size of the school site, the type of equipment, and the number of teachers with specific qualifications to be provided.

4. What should be taught in the school curricula, and what are the school offerings? In the larger school systems this problem may be the responsibility of the assistant superintendent in charge of elementary schools, assistant superintendent in charge of junior high schools, and assistant superintendent in charge of senior high schools, or it may be the responsibility of the superintendent or of the director of research and education. It is an important problem and one that should be given serious thought and consideration far in advance of preparing budget estimates. The comprehensive school is quite different from a specialized school. Schools for handicapped children have a problem all of their own. Consideration must be given to the curricula of the schools in question, the courses of study to be used, and the detail and extent to which the school offerings are to be taught.

To a large extent these problems are decided by the state legislature and are more or less fixed. Nevertheless, it does not relieve the budget-builder from analyzing and evaluating the factors involved. The school curriculum is constantly changing; therefore courses of study are in a continuous process of revision. New subject-matter affected by changed social and economic conditions is the ultimate result.

5. What should be the specifications for the salary schedule of school employees? Foremost in this issue is the schedule of qualifications for teachers and the amount of money that is available with which to pay the teachers. The educational program is determined to a large measure by the kind of teachers employed in the school system. Ordinarily, teachers will not stay in a school system where they are poorly paid if they have an opportunity to go elsewhere. As a consequence, it often happens that the good teachers go elsewhere and the poor teachers stay in the school system that pays low salaries.

In Indiana as well as in other states the qualifications of the teachers are set by the legislature or established by the state board of education. In connection with teacher requirements, the budget-builder must consider a number of questions: (1) What shall be the minimum training required for teachers in the local school system considering the laws of the state, the rules and regulations of the state board of education, and the rules and regulations established by the local board of education? (2) What recognition should be made of experience in teaching, number of years taught, and subjects taught? (3) What provisions should be made for special training in specific tasks in teaching? A teacher who is to teach health and physical education, though the subject may be taught only during a part of the day, should have special training in health and physical education. (4) Shall the schedule make provision for stimulating professional progress among the teachers? Are they to be given Sabbatical leaves of absence, and bonuses for travel and for additional training during the vacation period?

Careful consideration should be given to the employment of school administrators, school clerks, school engineers, custodians, and matrons. A good custodian is as important in the school building as a good teacher. His duties have a direct bearing upon all who are housed in the school plant. He is directly responsible for the cleanliness, sanitation, heating, and ventilation of the building, and should not only be a man skilled

in the operation of the school plant, but should also be an outstanding individual with regard to character and personality. The custodian meets perhaps as many children as any teacher and must know child psychology if he is to be a good custodian.

What is true of the custodian is true of the matron, the engineer, and the school clerk. It is of extreme importance in budget building that the proper qualifications are set forth for each position to be filled and that the people who are employed are qualified to do the work which is expected of them. Reasonable compensation for services rendered should be incorporated in the budget because it is an integral part of the program of the entire school system.

It is desirable to have trained experts conduct demonstration schools, classes in physical education, and classes in certain other specialized fields for the good of the system at large. The expense of carrying on such a program should be made a part of the school budget. A training school within the system for engineers and custodians is of utmost importance in developing new techniques and skills in school plant operation. The expense of such a training school should be borne by the school system. Anything that contributes directly or indirectly to the educational progress of the pupils should be considered in the school budget. Certain practical limitations must of course be considered, but in the main an attempt should be made to support an adequate educational program.

6. How many teachers should be employed in a given school system? In most schools the size of the classes is an important factor in determining the number of teachers to be employed. If it becomes an established fact that in certain classes in either elementary or high schools a certain number of children are to be taught, the matter of determining the expense will not be a prolonged one if the program for the ensuing school year is known. However, there will be a difference in expense if grades 1 to 6 inclusive are to be limited in size to 35 pupils instead of 50 pupils. Likewise, in the smaller high schools, if classes are to contain 65 pupils in certain subjects rather than 40 pupils, it is important to establish approximately the limit as to the number of pupils per class for the various subjects offered. The budget-builder will be helped materially in preparing his schedules and estimates if the number of teachers to be employed is known in advance.

7. What policies should be included in the educational program for the particular period in question? A comprehensive school survey has recently been made in the city of Evansville by the Division of Field Studies, Teachers College, Columbia University. Certain important recommendations will come from this survey and should be put in practice within the near future. Other recommendations will need to be worked into the educational program during the ensuing years. The fact that a survey has been made should concern most vitally those who are preparing the budget. There may be certain recommendations with respect to a testing program, more definite supervision of instruction, a summer school program, an entirely different program of health and physical education, and countless other important factors that would affect the school budget. The main elements in the educational philosophy of the

school will vary in school systems due to the size of the school, the location of the school, the social and economic factors that will affect the school program, and the ability of the community to finance the program.

8. What standards of educational specifications should be set up in determining the kind and amount of supplies and equipment needed to carry on the program? A careful study should be made of all classes and all grades by teachers and supervisors alike. Consideration should be given to the courses of study in determining the amount of material needed for each child and for each classroom. An excellent plan to follow in measuring the needs of the school system is to appoint teacher committees for each department of the school system to work for a period of time under the supervision of a supervisor or director of research in compiling a list of the needed supplies and equipment for the department in which they are concerned. These lists can include materials needed in carrying out the courses of study. It is well to prepare standard lists of supplies and equipment to be issued to each and every school for each and every department and have the school principal, together with his teachers and the help of the supervisors, determine the needs of his school at least six months to a year in advance. The standard lists, properly filled out, can take the place of the requisition for materials. These lists, of course, will be subject to revision each year because of changing conditions and revision in the courses of study.

School furniture and equipment becomes obsolete and must be replaced with modern equipment and apparatus. Whatever is done should be justified on the basis of educational need and should be intelligently interpreted to the public at large.

9. Should educational specifications for a building program be considered in the budget? It would be foolhardy for a school superintendent to expect his board of education to enter a year of wild spending in the erecting of new buildings, with the thought that he may not be able to build another building for five or ten years. Buildings that are constructed in this manner are usually not well thought out and planned and oftentimes miss the mark in providing adequate educational facilities. There must be long-time study and planning of a school building to be sure that it is adequate, flexible, well equipped, and properly constructed, and that it will serve the community to the greatest advantage. A well-defined school building program covering a period of years is a mark of good business administration.

10. Should a definite program of school maintenance, repairs, and alterations be carefully worked out? With the vast expenditure of money invested in buildings and equipment, it is highly important that a certain amount should be spent each year to maintain and keep the equipment in proper condition. It is false economy to neglect school property. The fact that building maintenance does not have immediate productive income has caused taxpayers and some educators to neglect it so that money can be spent elsewhere in the school budget. The public schools of America over a long-time period have productive income which cannot be evaluated in dollars and cents, but which is commensurate with the highest and noblest type of American citizenship.

There should be a painting schedule so that each year both the interior and exterior of certain buildings can be redecorated. Buildings that are left unpainted for a long time become dingy in appearance and detrimental to the health of the children, and frequently they lose the aesthetic beauty and charm that has been attached to that particular building. Buildings should be reshaded after so many years, floors should be repaired, window frames should be checked, the heating and ventilating system should be inspected periodically, and the physical equipment should be continually inspected and cared for. Fortunately for most school systems during the past few years, the federal program under the CWA, FERA, WPA, and PWA has helped materially in maintaining school property. Without this aid many school plants would have had to be abandoned because of insufficient care and attention.

The ten issues, herein given, which are involved in developing the educational program do not cover every phase that should be considered in all school systems. They do give an idea of the important issues that will arise each year in preparing the budget. It is wise always to follow a school calendar in keeping records of the budget. Three budgets should be kept in mind always: first, the one that is in operation; second, the budget that must be prepared for the ensuing school year; and third, the long-time budget program.

I have given you a résumé of what I consider to be a program of measuring the budgetary needs of the school system. When the needs are actually established, money should be set up in the budget and allocated to the specific accounts for the spending plan. The financing plan will involve securing revenue from state and federal sources and determining the local school tax rate so that the income will be sufficient to provide for the educational program. I have not attempted to explain the mechanics of school accounting or prescribe certain forms to follow. However, detailed reports and estimates with full and definite descriptions are essential in justifying the program to the taxpayer. Do not overlook the opportunity, first of all, to develop in the community an educational philosophy. With this accomplished, the educational program will receive encouragement and support from the taxpayers at large. The financing of the program will then be less difficult to handle.

The budgetary procedure in any school system is of utmost importance to the school administrator. His interest should permeate the entire school system to a point of building up a school consciousness in every school district in the entire community. It is by this means that the American schools will continue to grow and receive public support. It will be through this process that our social and economic ills can be corrected. Adequate schools of America are the salvation of American democracy.

Science as a Product of Social Coöperation (Abstract)

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THE history of the sciences furnishes innumerable examples of the fact that important discoveries, while made by individuals, are the outcomes of long processes of coöperative effort in the course of which facts and principles have gradually been contributed by many investigators. A realization of the fact that science depends on the union of efforts of many minds is at no time more important than in a period when a new field of inquiry is being opened up. It is quite certain that the early stages of any line of scientific study will exhibit points of view and theories which are divergent and antagonistic because they are immature.

The science of education is in its early stages of development and the clash of views and the disagreements between eminent contributors are so conspicuous that there is confusion in the ranks of teachers and school administrators. These practical workers do not know what to accept and what to reject and they are often discouraged about the possibility of solving the problems of the schools by scientific methods.

A survey of the history of the science of education gives one encouragement to believe that the present situation represents a transition stage and that in due course the differences between workers will disappear and there will result a large body of accepted principles.

The beginnings of the science of education can be seen in the last decades of the nineteenth century. It is quite the custom for present-day writers in education to speak with disdain about the Herbartians, G. Stanley Hall, and other pioneers in the study of educational phenomena and child development. It is true that the methods of inquiry employed in the "eighties" and the "nineties" were crude, but so were the early and inexact methods in the natural sciences.

The opening of the present century ushered in the extensive use of the methods of statistical measurement. There is evidence that some of the conclusions reached by gross measurements of physical and mental development will have to be revised in the light of more complete studies of individual development. The arduous methods of laboratory analysis which transformed psychology and gave it a place among the empirical sciences have only recently been employed with vigor in the field of education, but where they have been applied, as, for example, in the study of reading, they have proved highly productive.

It is not alone in methods of inquiry that the science of education has made marked progress in recent years. In substantial knowledge with regard to the nature of learning there have been gratifying advances. The discontent which is shown by numerous new formulations of educational psychology is not to be looked upon as discouraging. Discontent and new efforts to interpret what is known are signs of progress.

To be sure, they also indicate that progress is hampered by a lack of all the materials necessary for final agreement on accepted principles.

The critics of the science of education seem to have forgotten that science is not the result of the insights of single genius. Every genius depends on a long line of earlier workers who cleared away some of the obscurities of mythology, raised penetrating questions, and found pertinent facts. The moment that one takes the historical view that science is the product of social coöperation, one is relieved of all the discouragements which result from too close a contact with the crudities of science in the making.

A List of Bulletins in the Field of Education, Indiana University

The following is a list of the bulletins published by the School of Education, Indiana University.

All bulletins which are available at the present time may be secured for fifty cents ($.50) per copy, with the exception of the *Second Revision of the Bibliography of Educational Measurements;* the *Bibliography of School Buildings, Grounds and Equipment—Part I; The Philosophy of Human Relations—Individual and Collective;* the *Bibliography of School Surveys and of References on School Surveys;* and the *Bibliography of College and University Buildings, Grounds, and Equipment,* which may be secured for seventy-five cents ($.75) per copy. *The Philosophy of Human Relations—Individual and Collective* and all fifty-cent bulletins of the School of Education may be obtained from the University Bookstore. The other four bulletins should be ordered through the Bureau of Coöperative Research, Indiana University.

Proceedings of the High School Principals' Conference (November 23 and 24, 1923). Vol. I, No. 1, 1924. 85 p. (Supply exhausted.)

Investigation of Nursing as a Professional Opportunity for Girls. Part I, Technical Study; Part II, Vocational Information Bulletin. By Florence E. Blazier. Vol. I, No. 2, 1924. 69 p.

Proceedings of the Eleventh Conference on Educational Measurements. Vol. I, No. 3, 1925. 141 p.

Proceedings of the High School Principals' Conference (November 14 and 15, 1924). Vol. I, No. 4, 1925. 49 p. (Supply exhausted,)

First Revision of the Bibliography of Educational Measurements. Compiled by the Bureau of Coöperative Research. Vol. I, No. 5, 1925. 147 p. (Supply exhausted.)

Proceedings of the Twelfth Conference on Educational Measurements. Vol. I, No. 6, 1925. 76 p.

The Effect of Population upon Ability to Support Education. By Harold F. Clark. Vol. II, No. 1, 1925. 28 p.

Proceedings of the High School Principals' Conference (November 20 and 21, 1925). Vol. II, No. 2, 1925. 77 p. (Supply exhausted.)

A Cross-Indexed Bibliography on School Budgets. By Harold F. Clark. Vol. II, No. 3, 1926. 66 p.

A Comparison of the Results Made on Certain Standardized Tests by Pupils in the Bloomington High School Who Were Taught in Classes of the Same Grade by University Student Teachers and by Regular High School Teachers. By Carl G. F. Franzén. Vol. II, No. 4, 1926. 19 p.

Proceedings of the Thirteenth Annual Conference on Educational Measurements. Vol. II, No. 5, 1926. 103 p.

When to Issue School Bonds. By Harold Florian Clark and Paul Royalty. Vol. II, No. 6, 1926. 16 p.

Students' Attitude Toward Examinations. By Grover T. Somers. Vol. III, No. 1, 1926. 48 p.

Proceedings of the High School Principals' Conference (November 12 and 13, 1926). Vol. III, No. 2, 1926. 27 p.

Index Numbers in School Administration. By Harold F. Clark. Vol. III, No. 3, 1927. 35 p.

Topical Analysis of 284 School Surveys. Compiled by the Bureau of Coöperative Research. Vol. III, No. 4, 1927. 111 p. (Supply exhausted.)

Proceedings of the Fourth Annual Conference on Elementary Supervision. Vol. III, No. 5, 1927. 64 p.

Proceedings of the Fourteenth Annual Conference on Educational Measurements. Vol. III, No. 6, 1927. 66 p.

Some Phases of the Junior College Movement. By I. Owen Foster, Harold F. Clark, Willard W. Patty, and Leo M. Chamberlain. Vol. IV, No. 1, 1927. 125 p. (Supply exhausted.)

Second Revision of the Bibliography of Educational Measurements. By Henry Lester Smith and Wendell William Wright. Vol. IV, No. 2, 1927. 251 p.

Bibliography of School Buildings, Grounds, and Equipment, Part I. By Henry Lester Smith and Leo Martin Chamberlain. Vol. IV, No. 3, 1928. 326 p.

Proceedings of the High School Principals' Conference (November 18 and 19, 1927). Vol. IV, No. 4, 1928. 54 p.

The Economic Effects of Education. By Harold F. Clark. Vol. IV, No. 5, 1928. 39 p.

Proceedings of the Fifteenth Annual Conference on Educational Measurements. Vol. IV, No. 6, 1928. 73 p.

Proceedings of the Fifth Annual Conference on Elementary Supervision. Vol. V, No. 1, 1928. 54 p.

Proceedings of the High School Principals' Conference (November 16 and 17, 1928). Vol. V, No. 2, 1928. 33 p.

The Development and Use of a Composite Achievement Test. By Wendell William Wright. Vol. V, No. 3, 1929. 90 p.

An Analysis of the Attitudes of American Educators and Others Toward a Program of Education for World Friendship and Understanding. By Henry Lester Smith and Leo Martin Chamberlain. Vol. V, No. 4, 1929. 109 p.

Tentative Program for Teaching World Friendship and Understanding in Teacher Training Institutions and in Public Schools for Children Who Range from Six to Fourteen Years of Age. By Henry Lester Smith and Sherman Gideon Crayton. Vol. V, No. 5, 1929. 54 p.

Proceedings of the Sixteenth Annual Conference on Educational Measurements. Vol. V, No. 6, 1929. 96 p.

Proceedings of the Sixth Annual Conference on Elementary Supervision. Vol. VI, No. 1, 1929. 73 p.

An Analysis of the Duties of County School Superintendents and Superintendents of Schools in Certain Cities in Indiana. By Henry Lester Smith and Leo Martin Chamberlain. Vol. VI, No. 2, 1929. 94 p.

Proceedings of the High School Principals' Conference (November 22 and 23, 1929). Vol. VI, No. 3, 1930. 51 p.

Coöperative Studies in Secondary Education. By Henry Lester Smith and Carl G. F. Franzén. Vol. VI, No. 4, 1930. 121 p.

Proceedings of the Seventeenth Annual Conference on Educational Measurements. Vol. VI, No. 5, 1930. 103 p.

Proceedings of the Seventh Annual Conference on Elementary Supervision. Vol. VI, No. 6, 1930. 102 p.

A Study in Teacher Supply and Demand in Indiana. By I. Owen Foster, Robert K. Devricks, Harry N. Fitch, Earl C. Bowman, and George L. Roberts. Vol. VII, No. 1, 1930. 77 p.

Proceedings of the High School Principals' Conference (November 7 and 8, 1930). Vol. VII, No. 2, 1930. 70 p.

The Philosophy of Human Relations: Individual and Collective—A Source Book. By Henry Lester Smith and Levi McKinley Krueger. Vol. VII, No. 4, 1931. 107 p.

The Psychology of Human Relationships: Individual and Social—A Source Book. By Henry Lester Smith and Levi McKinley Krueger. Vol. VII, No. 4, 1931. 107 p.

Proceedings of the Eighteenth Annual Conference on Educational Measurements. Vol. VII, No. 5, 1931. 83 p.

Efficiency in College Management. By John Dale Russell. Vol. VII, No. 6, 1931. 143 p.

Bibliography of School Surveys and of References on School Surveys. By Henry Lester Smith and Edgar Alvin O'Dell. Vol. VIII, Nos. 1 and 2, 1931. 212 p.

Proceedings of the Nineteenth Annual Conference on Educational Measurements. Vol. IX, No. 1, 1932. 139 p.

Bibliography of School Buildings, Grounds, and Equipment—Part II. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. IX, No. 2, 1933. 182 p.

Bibliography of School Buildings, Grounds, and Equipment—Part III. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. IX, No. 3, 1933. 130 p.

A Brief Summary of Literature on Leadership. By Henry Lester Smith and Levi McKinley Krueger. Vol. IX, No. 4, 1933. 80 p.

Proceedings of the Twentieth Annual Conference on Educational Measurements. Vol. X, No. 1, 1933. 98 p.

Bibliography of College and University Buildings, Grounds, and Equipment. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. X, No. 2, 1934. 199 p.

Factors Affecting the Organization of School Attendance Units. By Raleigh Warren Holmstedt. Vol. X, No. 3, 1934. 32 p.

The Old World Historical Background of Religious and Moral Education in Schools. By Henry Lester Smith, Robert Stewart McElhinney, and George Renwick Steele. Vol. X, No. 4, 1934. 144 p.

Proceedings of the Twenty-first Annual Conference on Educational Measurements. Vol. XI, No. 1, 1934. 96 p.

Bibliography of School Buildings, Grounds, and Equipment—Part IV. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. XI, No. 2, 1935. 216 p.

A Brief Survey of Present-Day Religious and Moral Education in the Schools of Countries Other Than the United States of America. By Henry Lester Smith, Robert Stewart McElhinney, and George Renwick Steele. Vol. XI, No. 3, 1935. 185 p.

Some Practical Efforts to Teach Good Will. By Henry Lester Smith and Peyton Henry Canary. Vol. XI, No. 4, 1935. 169 p.

Twenty-second Annual Conference on Educational Measurements. Vol. XII, No. 1, 1935. 97 p.

A Basis for the Improvement of Education in Rural Monroe County, Indiana. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. XII, No. 2, 1936. 168 p.

Reading Readiness—A Prognostic Study. By Wendell William Wright. Vol. XII, No. 3, 1936. 46 p.